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Relationships among Kentucky's Core Content Test, ACT Scores, and Students' Self-Reported High School Grades for the Classes of 2000 Through 2002

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Abstract

As a part of Kentucky's ongoing examination of the validity and reliability of the Kentucky Core Content Test (KCCT), a major component of the Commonwealth Accountability Testing System (CATS), KCCT scores were compared with ACT scores for the period from 1999-2002. This report updates a similar study conducted by Hoffman (1998) comparing ACT scores with scores from KCCT's predecessor, the Kentucky Instructional Results Information System (KIRIS). Results were much the same as found during the earlier study. KCCT scores are correlated with ACT scores at the student and school level. In addition, students' self-reported grades and number of courses in mathematics and science are correlated with ACT and KCCT scores. Correlations between same-subject tests typically ranged from 0.50 to 0.65, indicating that while the different measures are related, they are not so highly related as to indicate that they are testing essentially the same set of content and skills. They are within the "Goldilocks" range, or not so high that they indicate that the tests do not have important differences, but not so low as to indicate that they measure entirely different content.

Kentucky students' KCCT scores have improved steadily over the three years studied while ACT scores, with the exception of mathematics, have declined slightly. Part of the analyses conducted as part of this study examined this pattern. In addition to student-level correlations, school-level correlations were also positive, indicating that if a school's mean score on KCCT was high, its mean ACT score was also high. When change in score was analyzed, a smaller correlation, which is expected from analysis of change scores, emerged. In all cases, this correlation was positive. However, the decline was small, and for schools that improved a great deal on KCCT it was smaller than for schools with smaller increases, allowing the positive correlation to emerge. So, although not immediately obvious, the data does not support the idea that the two tests represent divergent content. More simply, preparing students to do well on KCCT does not preclude them from doing as well on the ACT; in fact, the opposite is true. Schools that gained on KCCT had smaller losses, or even posted gains, on ACT.

Relationships Among Kentucky's Core Content Tests, ACT Scores, and Students' Self-Reported High School Grades for the Classes of 2000 through 2002

Executive Summary

Kentucky's public school students took the Kentucky Core Content Test (KCCT), part of the Commonwealth Accountability Testing System (CATS), for the first time in 1999. KCCT replaced the Kentucky Instructional Results Information System (KIRIS) tests, which were administered as part of the state's testing and accountability system since spring 1992. Several changes were implemented during the transition from KIRIS to CATS. For example, multiple-choice components in each content area were added to the formula used to calculate school accountability indexes. Accountability indexes determine whether a school receives rewards, assistance, and/or additional scrutiny during its attempts to improve. Each school's index is related to an overall goal designed such that all schools will reach an index of 100 out of a possible 140 by 2014. KIRIS used only open-response items to determine school accountability indexes. Open-response components are given twice the weight of multiple-choice components in the CATS index calculation. Open-response items have been included in the accountability system since its inception to ensure that Kentucky students are able to apply knowledge, rather than merely to recall disconnected facts.

During the first years following the introduction of this new accountability system, it is critical that information on the validity of the KCCT exams be gathered. The purpose of this report is to contribute to the literature regarding one particular validity issue: *How are KCCT scores related to other measures of educational achievement?* Three "other measures" are examined in this report, including student scores from the American College Test (ACT), students' reports about the number of high school courses taken, and students' reports about course grades attained. Both types of students' self reports were gathered from the ACT assessment registration. This report is an update of previous analyses of the KIRIS tests and ACT (Hoffman, 1998). It represents one step in exploring the validity of KCCT. Results from this report should be considered in tandem with studies related to the meanings of individual student KCCT scores and the use of those scores for making attributions about school-level effectiveness (Hoffman and Bacci, 2003; Hoffman and Wise, 2002).

Data for these analyses were provided by the Kentucky Department of Education (KDE). ACT data consisted of separate annual data files for Kentucky public school students graduating in 1999 through 2002. The Kentucky assessment data consisted of a set of three separate data files for 10^{th} grade students from 1999 and 2000; 11^{th} grade students from 1999 to 2001; and 12^{th} grade students from 1999 to 2002. These data file sets included background data, student scale scores, and student survey responses. The file set for each grade was linked via a common identification number for that year. The Kentucky assessment files for a single year for a single grade were also merged using this common identification number.

Data in this report includes students from the 1998-1999, 1999-2000 and 2000-2001 KCCT testing years, organized by graduation years 2000 through 2002. KCCT is arranged such

that students take different component tests at different grade levels. As presented in Table A, 10th grade students are tested in Reading and Practical Living/Vocational Studies, 11th grade students in Math, Science, Social Studies and Arts & Humanities, and 12th grade students complete a writing portfolio. In addition, students complete a brief survey at the end of each subject-specific test. Writing portfolio data is not included in this report. Our concern was looking at scores on the subjects tested during the 10th and 11th grades. And, since KCCT was not implemented until spring 1999, graduating seniors for 2000 did not take the KCCT Reading and Practical Living sections. Table B illustrates the grade in which a given KCCT section was taken, organized by graduation year. All included students may have taken the ACT at any time during their high school career, with most taking it in their junior and senior years.

Table A. Subjects Tested by Grade Level

	10th Grade	11th Grade
Kentucky Tested Subjects	Reading Practical Living Student Survey	Math Science Social Studies Arts & Humanities Student Survey

Table B. Grade of Class for Each Year of Available Data Files

	Kentucky Assessment		
	1999	2000	2001
Graduating Class of 2002		10th Grade	11th Grade
Graduating Class of 2001	10th Grade	11th Grade	
Graduating Class of 2000	11th Grade		

ACT reports student achievement scores in four content areas: English, Reading, Mathematics, and Science Reasoning. An overall composite score is also calculated and reported for the ACT. A student's performance on the ACT is directly related to his/her plans for secondary education. ACT scores are taken into consideration as part of the admissions process in all Kentucky public colleges and universities. ACT must be taken prior to entering Kentucky's Vocational/Technical schools and community colleges. Students also earn Kentucky Educational Excellence Scholarship (KEES) funds for high scores on the ACT that can be applied to college tuition or expenses.

The ACT student registration packet contains a variety of questionnaire items, including a self-reported high school transcript. From a list of commonly offered courses in language arts, mathematics, natural sciences, social sciences and foreign language, students indicate the courses they have completed and those they plan to complete before high school graduation. Students also indicate grades received for completed courses and current courses that they have been taking for at least one semester. Reported grades were used to calculate a grade point average (GPA) for appropriate subjects.

Observations

Students who take the ACT are a self-selected population who usually take the assessment as part of their plans for continuing education beyond high school. As expected of a population with aspirations for higher education, the students in this group score higher, as indicated by the student-level mean score on the KCCT assessment, than the general population of Kentucky students. For that reason, results presented in this study are most conclusive for students in the upper portion of the KCCT score distribution.

Both KCCT and ACT assessments are intended to measure students' abilities to apply academic content knowledge acquired during high school (ACT, 1997; KDE, 2002). However, four potential differences between the assessments should be mentioned. First, a student's motivation may differ on the two exams. KCCT test results are used to evaluate schools and have no direct consequences for an individual student. ACT performance, on the other hand, can significantly affect a student's post-secondary plans.

Second, the two assessments may differ in the particular domains they assess. The KCCT assessment targets an achievement domain developed by Kentucky educators, the Kentucky Core Content for Assessment (KDE, 1996). ACT Assessment tests "are based on and oriented toward the major areas of secondary and postsecondary instructional programs" (ACT, 2003).

Third, the testing formats differ. Open-response items, which are a component of KCCT, have been widely promoted over the last several years as a means for providing students with greater opportunities to demonstrate multiple and differing problem-solving tactics (Hoffman and Tannen, 1998). The presumption is that these different approaches are more difficult to capture when using only multiple-choice items. ACT uses only multiple-choice items.

Lastly, the two tests were designed for very different purposes. KCCT is designed to measure school-level achievement over a very wide range of content. To accomplish that goal, KCCT uses multiple forms (6 in Math, Reading, Science, and Social Studies and 12 in Arts & Humanities and Practical Living/Vocational Studies) within each grade/subject test, each with a different set of items. Of course the forms are equated to ensure comparability, but it is important to keep in mind that the end goal of KCCT is to use those individual student scores to calculate a school-level index. ACT is designed for individual student-level reporting and school-level indexes are never computed.

Results and Discussion

As described by Hoffman (1998) in a validity plan regarding Kentucky's assessment and accountability system, correlations between two different but similar assessments should meet a "Goldilocks" criterion. That is, because the assessments are designed to measure student achievement differently, correlations should not be exceptionally high. On the other hand, the achievement domains are not expected to be independent (i.e., KCCT Math and ACT Math both test achievement in mathematics), and thus correlations should not be too low. The actual level of correlation that is desirable between two assessments should be mitigated by the degree of similarity between the two tests. Tests using differently formatted items would not be expected

to correlate as highly as tests using items with the same format. Also, the degree to which the content domain is similar will affect the correlation.

Student-level Analysis

Figures A, B, and C illustrate the relationships between Kentucky's KCCT scores and ACT scores for Reading, Mathematics, and Science. The box-and-whiskers plots represent the distribution of students on KCCT scores for varying levels of ACT. Each box represents 50% of the students within each ACT category. The median is represented by the line in the middle of the box. The whiskers represent the spread of the distribution of students. For a normal distribution, this spread should include approximately 99.3% of all students for the given category.

The plots in Figures A through C clearly indicate that students with higher ACT scores tend to have higher scale scores on the KCCT assessments. The relationships are not perfect (the correlations are generally near 0.60), but the trends are clear. The observed relationships between KCCT and ACT appear to be in the "not-too-low-and-not-too-high" category described by Hoffman's (1998) "Goldilocks" criterion.

Figures A through C also indicate the regions of the scale scores that correspond to Kentucky's Novice, Apprentice, Proficient, and Distinguished (NAPD) categories of performance. Two trends are apparent: students in this ACT-taking population tend not to score Novice and obtaining Distinguished performance is difficult, particularly for Reading and Science. That is, most of the highest level ACT students (scores of 33-36) score Proficient on KCCT Reading and Science, whereas most of those students score Distinguished on KCCT Mathematics.

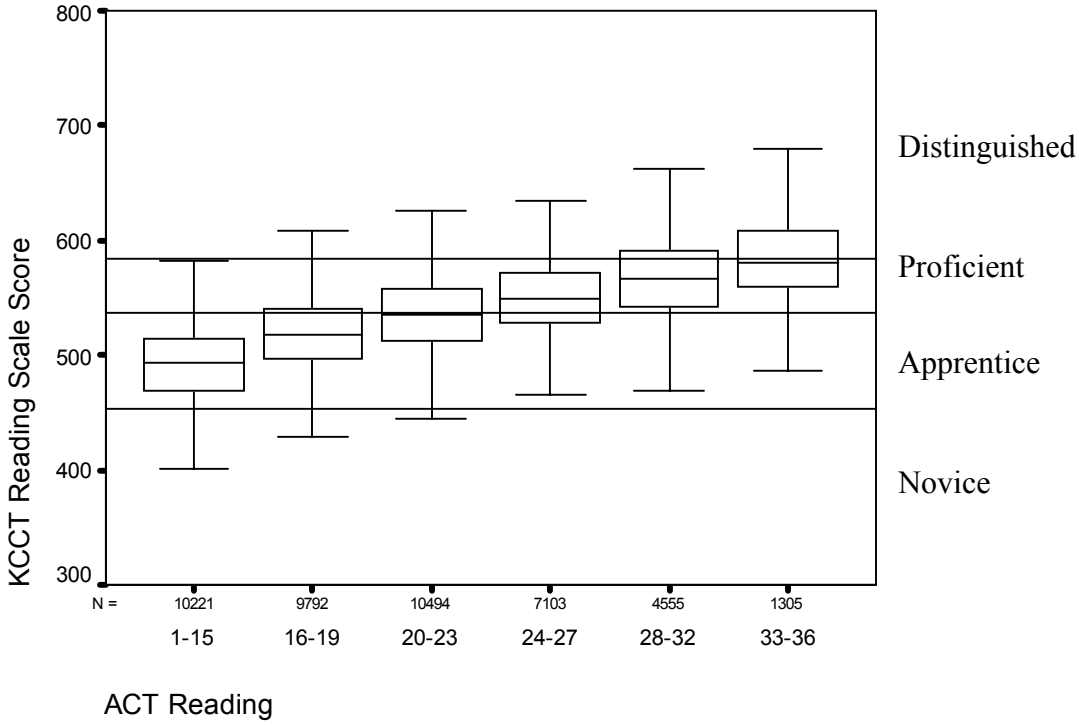

Figure A. Student-level relationship between KCCT Reading scale score and ACT Reading score for graduation years 2001 through 2002.

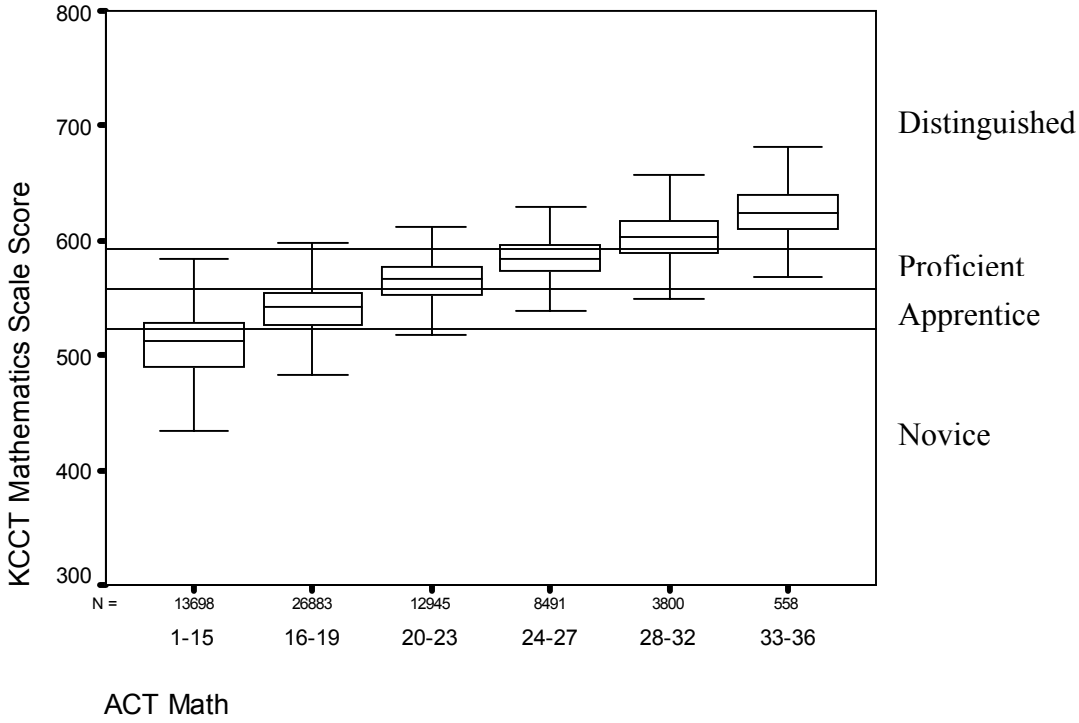

Figure B. Student-level relationship between KCCT Math scale score and ACT Math score for graduation years 2000 through 2002.

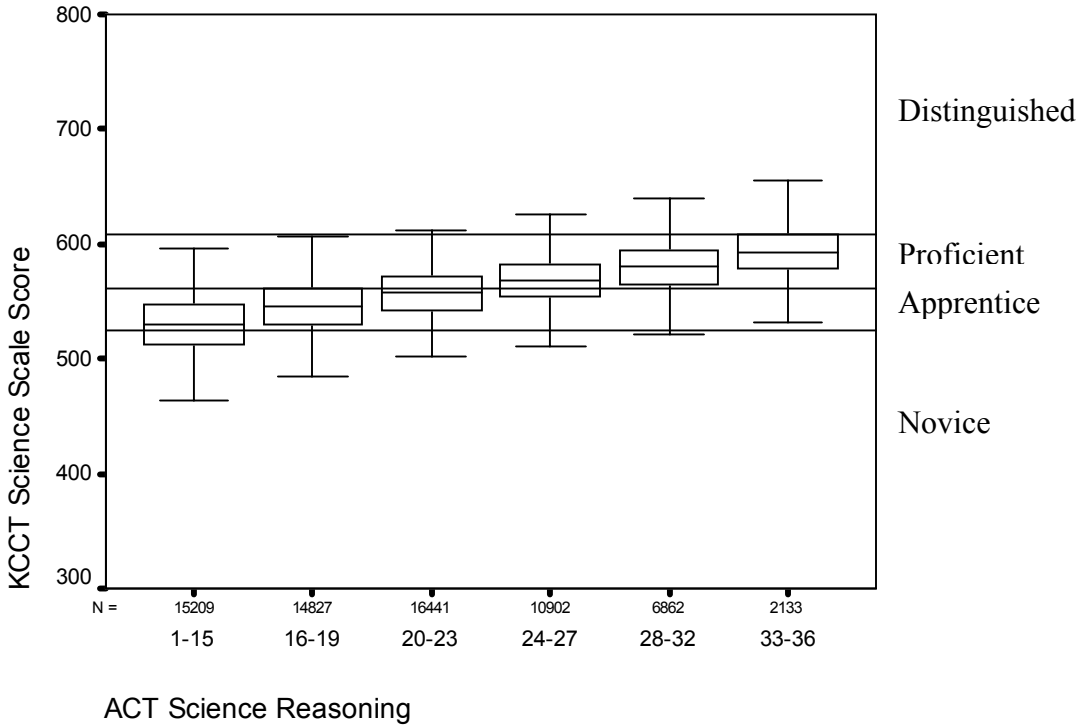

Figure C. Student-level relationship between KCCT Science scale score and ACT Science Reasoning score for graduation years 2000 through 2002.

Relationships between students' KCCT scale scores and high school GPA for reading, mathematics, science and social studies, and between KCCT scale scores and numbers of courses taken for mathematics, science, and social studies were also examined. Students with higher GPAs tend to do better on KCCT assessments as indicated by the scale scores. Students who take more math and science courses also tend to have higher KCCT scale scores. Students who take the required number of social studies courses tend to have higher KCCT scale scores than students taking either fewer or more than the required number of social studies courses. In addition to the student-level relationships matched by content area, additional analyses examined relationships across content areas and measurement methods (KCCT, ACT, GPAs) for students' individual scores and for students' scores averaged for each school.

School-level Analysis

When aggregated at the school level, KCCT mean scores generally increased between the 2000 and 2002 graduation years. During this same period, ACT mean scores, with the exception of math, experienced a decrease. School-level changes were computed over the three graduation years and correlated with one another. Table C presents correlations between changes in KCCT and ACT in subject-specific areas, with some initially confusing results.

Table C. Correlations Between Changes in KCCT and Changes in ACT Scores

	ACT Reading	ACT Math	ACT Science Reasoning
KCCT Reading	.386 (.366)*		
KCCT Math		.189 (.541)	
KCCT Science			.453 (.428)

*Correlations in parentheses were calculated after the removal of outliers. Outliers are change score values more than 3 standard deviations from the mean.

Correlations in Table C are all positive, indicating that changes among both assessments were moving in the same direction. In order to be sure that these correlations were not reflections of a few uncharacteristically large or small change scores, outliers (values that are more than 3 standard deviations above or below the mean) were removed and the correlations were recalculated. Those new values are presented in parentheses. In all three cases, the correlations remain positive. Figure D illustrates how this relationship is possible. In Figure D, changes in school-level KCCT science scores are plotted along with changes in school-level ACT science reasoning scores. A school that is plotted to the right of 0 on the X-axis and/or above 0 on the Y-axis experienced positive changes in ACT and/or KCCT scores, respectively.

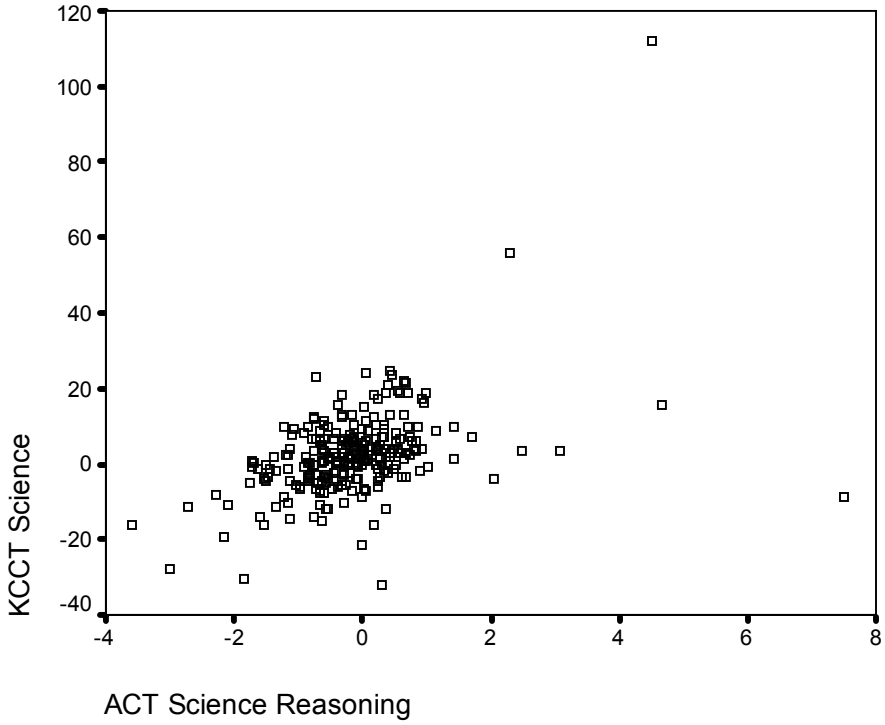

Figure D. Changes in KCCT science and ACT science between graduation years 2000-02.

As the scatterplot shows, more schools have positive changes in mean KCCT science scores and negative changes in ACT. However, the overall relationship is positive, because as we move in the positive direction along the X-axis, the cluster of scores as a whole moves in the positive direction in the Y-axis. Though ACT scores have experienced a decline, schools that have experienced higher gains on the KCCT tend to have smaller losses, or to have gained, on the ACT.

Summary and Conclusion

Two main points can be inferred from the student-level data. First, students who do well on any one measure of achievement tend to do well on all the measures of achievement, whether KCCT, ACT or GPA. Correlations between KCCT and ACT scores are consistent with those found between other established measures of student achievement (Thacker & Hoffman, 1999; Stroud, 1995; Sicoly, 2002). These results represent a strong indicator that the KCCT is a valid measure of student achievement. Second, at the school level, schools with high ACT scores also have high KCCT scores (among the ACT-taking student population). The relationship between GPA and both KCCT and ACT is much weaker at the school level than for individual students. However, this weak relationship is much stronger than that found by Hoffman (1998), perhaps indicating some standardization of grading practices among Kentucky schools.

Among school-level scores, mean KCCT scores have generally increased while ACT scores, with the exception of math, have been on the decline. Schools that have experienced higher gains in KCCT scores, however, tend to have experienced smaller losses, or at times to have gained, on ACT.

The full report addresses additional questions related to how KCCT "measures up" to the other achievement measures, including the relationships between the achievement measures and gender, racial, and socioeconomic (SES) differences. In addition, student motivation, as a potential source of differential performance on the KCCT and ACT, is briefly explored. KCCT student questionnaire items are also analyzed in order to explore school-level instructional practices and their relationship with KCCT scores.

Relationships Among Kentucky's Core Content Tests, ACT Scores, and Students' Self-Reported High School Grades for the Classes of 2000 through 2002

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INTRODUCTION

Kentucky's public school students took the Kentucky Core Content Test (KCCT), part of the Commonwealth Accountability Testing System (CATS), for the first time in 1999. KCCT replaced the Kentucky Instructional Results Information System (KIRIS) tests, which were administered as part of the state's testing and accountability system since spring 1992. Several changes were implemented during the transition from KIRIS to CATS. For example, multiple-choice components for each content area were added to the formula used to calculate school accountability indexes. Accountability indexes determine whether a school receives rewards, assistance, and/or additional scrutiny during its attempts to improve. Each school's index is related to an overall goal designed such that all schools will reach an overall index of 100 out of a possible 140 by 2014. KIRIS used only open-response components to determine school accountability indexes. Open-response components are given twice the weight of multiple-choice components in the CATS index calculation. Open-response components have been included in the accountability system since its inception to ensure that Kentucky students are able to apply knowledge, rather than merely to recall disconnected facts.

During the first years following the introduction of this new accountability system, it is critical that information on the validity of the KCCT exams be gathered. The purpose of this report is to contribute to the literature regarding one particular validity issue: *How are KCCT scores related to other measures of educational achievement?* Three "other measures" are examined in this report, including student scores from the American College Test (ACT), students' reports about the number of high school courses taken, and students' reports about course grades attained. Both types of students' self reports were gathered from the ACT assessment registration. This report is an update of previous analyses of the KIRIS tests and ACT (Hoffman, 1998). It represents one step in exploring the validity of KCCT. Results from this report should be considered in tandem with studies related to the meanings of individual student KCCT scores and the use of those scores for making attributions about school-level effectiveness (Hoffman & Bacci, 2003; Hoffman & Wise, 2002).

Both KCCT and ACT assessments are intended to measure students' abilities to apply academic content knowledge acquired during high school (ACT, 1997; KDE, 2002). However, four potential differences between the assessments should be mentioned. First, students' motivations may differ on the two exams. KCCT test results are used to judge schools and have no direct consequences for individual students. ACT performance, on the other hand, has direct implications for students' postsecondary plans.

Second, the two assessments may differ in the particular domains they assess. The KCCT assessment targets an achievement domain developed by Kentucky educators, the Kentucky Core Content for Assessment (KDE, 1996). ACT Assessment tests "are based on and oriented toward the major areas of secondary and postsecondary instructional programs" (ACT, 2003).

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greater opportunities to demonstrate multiple and differing problem-solving tactics. The presumption is that these different approaches are more difficult to capture when using only multiple-choice items. ACT uses only multiple-choice items.

Lastly, the two tests were designed for very different purposes. KCCT is designed to measure school-level achievement over a very wide range of content. To accomplish that goal, KCCT uses multiple forms (6 in Math, Reading, Science, and Social Studies and 12 in Arts & Humanities and Practical Living/Vocational Studies) within each grade/subject test, each with a different set of items. Of course the forms are equated to ensure comparability, but it is important to keep in mind that the end goal of KCCT is to use those individual student scores to calculate a school-level index. ACT is designed for individual student-level reporting and school-level indexes are never computed.

As described by Hoffman (1998) in a validity plan regarding Kentucky's assessment and accountability system, correlations between assessments using the open-response format and assessments using the multiple-choice format should meet a "Goldilocks" criterion. That is, because the assessments are designed to measure student achievement differently, correlations may not be exceptionally high. On the other hand, the achievement domains are not expected to be independent, and thus correlations should not be too low.

Scaling is another important issue concerning the interpretation of relationships between KCCT scores and other achievement scores. Students' KCCT scores go through several transformations before they are reported. First, students' responses to each open-response item are categorized by trained scorers into one of five raw score categories which are assigned numerical values from 0 to 4. Correct multiple-choice responses receive one point. Points are then summed in order to calculate a raw score. Open-response and multiple-choice raw scores are then converted into an equated scale score, which can range from 325 to 800. In the scaling processes, the open-response components are weighted so that they count twice as much as multiple-choice components (KDE, 2002).

Description of Data

Data for these analyses were provided by the Kentucky Department of Education (KDE). ACT data consisted of separate annual data files for Kentucky public school students graduating from 1999 through 2002. The Kentucky assessment data consisted of a set of three data files for the 10^{th} grade students from 1999 and 2000; 11^{th} grade students from 1999 to 2001; and 12^{th} grade students from 1999 to 2002. These data sets consisted of a background data file, a scale score file and files of student survey responses. The file set for each grade was linked via a common identification number for that year. The Kentucky assessment files for a single year for a single grade were also merged using this common identification number.

Since Kentucky students take different tests each year, data files had to be merged across years. The data from different years for each student was merged to obtain each student's results for tests taken in the 10^{th} and 11^{th} grades. The data for each student for their 10^{th} and 11^{th} grade years were merged using the student's last name, first name, middle initial, and date of birth obtained from the background data file. Four merge attempts were made. The first merge attempt was made on exact matches of last name, first name, date of birth and middle initial. The second

merge attempt was made using last name, first name and date of birth. The third merge attempt was made using last name, first name truncated to the first four letters, and date of birth. The fourth merge attempt was made using the last name truncated to the first four letters, the first name truncated to the first four letters, and the date of birth. After each merge attempt, three files were created—successfully merged student data, unmerged students from File 1, and unmerged students from File 2. Each successive merge attempt was made using only the unmerged student files. The four successfully merged student data files were then combined. The KCCT merged class files then were merged with the ACT data files using students' last name, first name, middle initial and date of birth using the same procedure previously described.

Table 1 presents the proportion of students retained in the final KCCT/ACT data set, reported by graduation year. Following the final merge cycle, roughly 91% of the original cases were retained. The successful merging of the files was hampered by inconsistent reporting of students' names across the years. For example, a student named 'Thomas' might report his name as 'Tom' during another year, and the two first names even when truncated would not match. Student errors and inconsistencies when coding their birthdates may also have caused a portion of students' files not to merge.

Table 1. Percentage of Students Retained in File Merge for Graduation Years 2000-2002

Graduation Year	Merge cycle	Number Retained	Percent of ACT Data File
2000	1st Merge (*last name, first name, date of birth, middle initial*)	17,414	70.4%
	2nd Merge (*last name, first name, date of birth*)	18,534	74.9%
	3rd Merge (*last name, truncated first name, date of birth*)	19,995	80.8%
	4th Merge (*Truncated last name, truncated first name, date of birth*)	21,999	88.9%
2001	1st Merge	19,530	78.6%
	2nd Merge	21,854	87.9%
	3rd Merge	22,422	90.2%
	4th Merge	22,686	91.3%
2002	1st Merge	17,362	70.5%
	2nd Merge	19,338	78.5%
	3rd Merge	20,777	84.4%
	4th Merge	22,938	93.2%

An additional analysis was conducted to verify that students retained in the final data set did not differ significantly on ACT scores from those whose data failed to merge. Table 2 through Table 4 present the means and standard deviations, and numbers of cases, for matched and all Kentucky public school students for each graduating class. Students whose data were merged scored slightly higher on all ACT components. Differences were quite small (no more than 0.16), but consistent.

Table 2. ACT Descriptive Statistics for Matched v. All Kentucky Graduating Class of 2000

	Matched Students			All Public School Students		
	Mean	S.D.	N	Mean	S.D.	N
English	19.81	5.57	21,999	19.65	5.58	24,732
Reading	20.67	5.84	21,997	20.53	5.86	24,731
Math	19.28	4.59	21,998	19.20	4.58	24,729
Science Reasoning	20.28	4.29	21,996	20.18	4.29	24,728
Composite	20.14	4.52	21,996	20.02	4.52	24,728

Table 3. ACT Descriptive Statistics for Matched v. All Kentucky Graduating Class of 2001

	Matched Students			All Public School Students		
	Mean	S.D.	N	Mean	S.D.	N
English	19.58	5.67	22,686	19.47	5.67	24,859
Reading	20.55	5.85	22,686	20.45	5.85	24,859
Math	19.34	4.63	22,686	19.28	4.62	24,859
Science Reasoning	20.24	4.43	22,686	20.17	4.44	24,859
Composite	20.05	4.60	22,686	19.97	4.60	24,859

Table 4. ACT Descriptive Statistics for Matched v. All Kentucky Graduating Class of 2002

	Matched Students			All Public School Students		
	Mean	S.D.	N	Mean	S.D.	N
English	19.35	5.72	22,938	19.27	5.73	24,624
Reading	20.51	5.87	22,938	20.42	4.61	24,624
Math	19.33	4.61	22,938	19.29	5.89	24,624
Science Reasoning	20.13	4.30	22,938	20.07	4.32	24,624
Composite	19.96	4.55	22,938	19.89	4.56	24,624

Data in this report includes students from the 1998-1999, 1999-2000 and 2000-2001 KCCT testing years, organized by graduation years 2000 through 2002. KCCT is arranged such that students take different component tests at different grade levels. As presented in Table 5, 10th grade students are tested in Reading and Practical Living/Vocational Studies, 11th grade students in Math, Science, Social Studies and Arts & Humanities, and 12th grade students complete a writing portfolio. In addition, students complete a brief survey at the end of each subject-specific test. The writing portfolio data is not included in this report. Our concern was looking at scores on the subjects tested during the 10th and 11th grades. And, since KCCT was not implemented until spring 1999, graduating seniors for 2000 did not take the KCCT Reading and Practical Living sections. Table 6 illustrates the grade in which a given KCCT section was taken, organized by graduation year. All included students may have taken the ACT at any time during their high school career, with most taking it in their junior and senior years.

Table 5. KCCT Tested Subjects for Each Grade

	10th Grade	11th Grade
Kentucky Tested Subjects	Reading Practical Living Student Survey	Math Science Social Studies Arts & Humanities Student Survey

Table 6. Grade of Class for Each Year of Available ACT Data Files

	1999	2000	2001
Graduating Class of 2002		10th Grade	11th Grade
Graduating Class of 2001	10th Grade	11th Grade	
Graduating Class of 2000	11th Grade		

ACT computes and reports student achievement scores in four content areas: English, Reading, Mathematics, and Science Reasoning. The ACT is designed to assess academic skills required for college by requiring students to "solve problems, grasp implied meanings, draw inferences, evaluate ideas, and make judgments in subject-matter areas important in college" (ACT, 1997, p. 2). As indicated earlier, the test's content is created from state-level academic standards and state-adopted textbooks. It is then reviewed by secondary and post-secondary educators. The degree to which ACT content matches Kentucky's *Core Content for Assessment* is unknown.

Finally, the ACT student application form contains a variety of questionnaire items, including a self-reported high school transcript. From a list of commonly offered courses in subjects including language arts, mathematics, natural sciences, social sciences and foreign language, among others, students indicate which courses they have completed and which they plan to complete before high school graduation. Students also indicate grades they have received for completed courses and current courses they have taken for at least one semester. Reported grades were used to calculate a grade point average (GPA) for the appropriate subject. Calculated GPA used a typical four-point scale where A=4, B=3, C=2, D=1, and F=0. Classes were selected based on whether or not a "typical" student would be expected to take the course. For example, every student takes an English class during a given year, while not every student would be expected to take a course in pre-calculus.

Table **7** indicates which courses were used to calculate GPA for each subject area. The ACT questionnaire includes a question about overall student GPA, but it was not used in this report. The questions asked students to choose from a set of categories that best described their overall GPA. Due to the categorical nature in which overall GPA was measured, it was not useful for reporting statistics such as mean and standard deviation.

Table 7. Courses Used to Calculate GPA

	Courses Used
English GPA	9th Grade, 10th Grade, and 11th Grade English
Math GPA	Algebra I, Algebra II, Geometry
Science GPA	Biology, Chemistry
Social Studies GPA	U.S. History, World History

Descriptive Statistics

Table 8 presents means, standard deviations, and numbers of students for each of the three cohorts and each of the achievement measures. The KCCT measures are reported using an equated scale score, ranging from 325-800.

Mean levels of performance in Table 8 apply to the population of ACT-taking students. As a means of comparison, KCCT means and standard deviations for unmatched students (students who did not take the ACT plus any students whose data were not successfully merged) and all Kentucky students are presented as well. KCCT means are higher and standard deviations generally lower for the ACT-taking students. These differences are to be expected and indicate that results presented in this study are most conclusive for the upper portion of the KCCT score distribution.

Table 8 shows that KCCT performance rose from 2000-2002, with most measures showing steady increases. Conversely, with the exception of Math, ACT scores (Table 9) showed a decline over the years. GPA (Table 10) exhibited the least amount of change over time. A small increase in the number of students taking the ACT test from 2000 to 2001 to 2002 may account for the slight decrease in mean scores on ACT during this period. The larger number of students taking the ACT may indicate a reduction in the selectivity of the group. More simply, Kentucky's high-ability students have traditionally taken the ACT, so an increase in the total number of students taking the test may indicate the inclusion of additional lower-ability students.

Table 8. KCCT Descriptive Statistics for Graduating Classes 2000 Through 2002 With Matched Students, Unmatched Students and All Kentucky Students

		Graduating Class of 2000			Graduating Class of 2001			Graduating Class of 2002		
		Matched	Unmatched	Total	Matched	Unmatched	Total	Matched	Unmatched	Total
Reading	Mean	NA*			525.73	468.84	495.63	531.11	474.54	502.56
	S. D.	NA			45.14	54.89	57.96	45.67	54.72	57.83
	N	0			21,540	24,199	45,739	21,930	22,339	44,269
Math	Mean	544.35	495.33	521.95	547.01	495.32	523.60	549.99	501.59	529.25
	S. D.	41.25	60.78	56.64	40.44	59.55	56.24	38.80	55.70	52.57
	N	21,999	18,520	40,519	22,071	18,267	40,338	22,306	16,728	39,034
Science	Mean	551.47	514.90	534.75	553.48	515.68	536.36	554.11	519.24	539.17
	S. D.	32.17	51.24	45.76	32.41	51.27	46.03	31.17	47.50	42.66
	N	21,999	18,520	40,519	22,071	18,267	40,338	22,306	16,728	39,034
Social Studies	Mean	561.03	508.61	537.07	563.73	508.33	538.64	564.89	510.32	541.51
	S. D.	44.03	58.68	57.52	44.74	58.68	58.44	46.55	56.20	57.63
	N	21,999	18,520	40,519	22,071	18,267	40,338	22,306	16,728	39,034
Arts & Humanities	Mean	524.05	468.89	498.83	530.60	472.97	504.50	539.48	480.87	514.51
	S. D.	58.39	60.91	65.59	57.86	63.12	66.77	59.01	62.47	57.63
	N	21,999	18,520	40,519	22,071	18,267	40,338	22,306	16,728	39,034
Practical Living	Mean	NA			528.57	473.29	499.33	529.13	475.49	502.06
	S. D.	NA			58.73	62.84	66.89	56.67	60.93	64.68
	N	0			21,540	24,199	45,739	21,930	22,339	44,269

*KCCT was changed in 1999. Therefore, tests given prior to 1999 were not used.

Table 9 ACT Descriptive Statistics for Graduating Classes 2000 Through 2002 With Matched Students, Unmatched Students and All Kentucky Students

		Graduating Class of 2000			Graduating Class of 2001			Graduating Class of 2002		
		Matched	Unmatched	Total	Matched	Unmatched	Total	Matched	Unmatched	Total
English	Mean	19.81	18.40	19.65	19.58	18.33	19.47	19.35	18.12	19.27
	S. D.	5.57	5.45	5.58	5.67	5.62	5.67	5.72	5.78	5.73
	N	21999	2733	24732	22686	2173	24859	22938	1686	24624
Reading	Mean	20.67	19.43	20.53	20.55	19.45	20.45	20.51	19.25	20.42
	S. D.	5.84	5.85	5.86	5.85	5.81	5.85	5.87	5.96	5.89
	N	21997	2732	24729	22686	2173	24859	22938	1686	24624
Math	Mean	19.28	18.60	19.20	19.34	18.67	19.28	19.33	18.78	19.29
	S. D.	4.59	4.37	4.58	4.63	4.44	4.62	4.61	4.59	4.61
	N	21998	2733	24731	22686	2173	24859	22938	1686	24624
Science Reasoning	Mean	20.28	19.42	20.18	20.24	19.41	20.17	20.13	19.31	20.07
	S. D.	4.29	4.18	4.29	4.43	4.38	4.44	4.30	4.53	4.32
	N	21996	2732	24728	22686	2173	24859	22938	1686	24624
Composite	Mean	20.14	19.09	20.02	20.05	19.10	19.97	19.96	18.99	19.89
	S. D.	4.52	4.36	4.52	4.60	4.48	4.60	4.55	4.62	4.56
	N	21996	2732	24728	22686	2173	24859	22938	1686	24624

Table 10. GPA Descriptive Statistics for Graduating Classes 2000 Through 2002

Subject		Graduating Class of 2000	Graduating Class of 2001	Graduating Class of 2002
English	Mean	3.20	3.20	3.21
	S. D.	.70	.70	.69
	N	17962	18255	18345
Math	Mean	3.15	3.15	3.15
	S. D.	.75	.75	.76
	N	15994	16579	16838
Science	Mean	3.18	3.18	3.18
	S. D.	.75	.75	.75
	N	15614	16114	15955
Social Studies	Mean	3.33	3.33	3.35
	S. D.	.71	.70	.70
	N	16256	16809	17358

Table 11 presents mean KCCT and ACT scale scores for the graduating classes of 2000, 2001, and 2002. Table 12 presents changes in these mean scores across the three graduation years. Mean KCCT and ACT scores in all subjects have changed only slightly over the years. Though the pattern is such that KCCT scores have increased and ACT scores have decreased (with the exception of math), these changes are small. There is currently not enough difference in the two sets of scores to suggest that instructional practices are overemphasizing either KCCT or ACT content, or that the two assessments are measuring achievement in largely different ways.

Table 11. Mean Scale Scores by Graduation Year

	Graduating Class of 2000	Graduating Class of 2001	Graduating Class of 2002
KCCT			
Reading	NA*	525.73	531.11
Math	544.35	547.01	549.99
Science	551.47	553.48	554.11
Social Studies	561.03	563.73	564.89
Arts & Humanities	524.05	530.60	539.48
Practical Living	NA*	528.57	529.13
ACT			
English	19.81	19.58	19.35
Reading	20.67	20.55	20.51
Math	19.28	19.34	19.33
Science Reasoning	20.28	20.24	20.13
Composite	20.14	20.05	19.96

*KCCT was changed in 1999. Therefore, tests given prior to 1999 were not used.

Table 12. Changes in Mean Scales Across Graduation Years

	Mean Score Change 2000-2001	Mean Score Change 2001-2002	Mean Score Change 2000-2002
KCCT			
Reading	NA*	+ 5.38	NA*
Math	+ 2.66	+2.98	+ 5.64
Science	+ 2.01	+ 0.63	+ 2.64
Social Studies	+ 2.70	+ 1.16	+ 3.86
Arts & Humanities	+ 6.55	+ 8.88	+ 15.43
Practical Living	NA*	+ 0.56	NA*
ACT			
English	- 0.23	- 0.23	- 0.46
Reading	- 0.12	- 0.04	- 0.16
Math	+ 0.06	-0.01	+ 0.05
Science Reasoning	- 0.04	- 0.11	-0.15
Composite	- 0.09	- 0.09	-0.18

*KCCT was changed in 1999. Therefore, tests given prior to 1999 were not used.

Changes illustrated here represent the average score of all Kentucky students who took both the KCCT and the ACT assessments. When the data is aggregated at the school level, however, a different picture emerges. Table 13 presents correlations among the changes in school level means between graduation years 2000 and 2002 (between 2001 and 2002 for reading) for KCCT and ACT Reading, Math and Science. If the correlations are negative, then we would expect that as KCCT scores increased, ACT scores decreased. However, all correlations in Table 13 are positive, indicating, at the school level, KCCT and ACT scores have both experienced an increase. In order to be sure that these correlations were not reflections of a few uncharacteristically large or small change scores, outliers (values more than 3 standard deviations above or below the mean) were removed and the correlations were recalculated. Those new values are presented in parentheses.

Table 13. Correlations Between Changes in KCCT and Changes in ACT Scores

	ACT Reading	ACT Math	ACT Science Reasoning
KCCT Reading	.386 (.366)*		
KCCT Math		.189 (.541)	
KCCT Science			.453 (.428)

*Correlations in parentheses were calculated after the removal of outliers. Outliers are change score values more than 3 standard deviations from the mean.

The findings presented in Tables 11 through 13 raise an interesting question. If school-level mean KCCT scores are increasing and school-level mean ACT scores are decreasing, how are the two positively correlated? Figures 1 through 3 illustrate how this is indeed possible. In Figure 3, for example, more schools have changes in mean KCCT science scores that are above 0

on the Y-axis. Conversely, more schools have changes in mean ACT science reasoning scores that are below 0 on the X-axis. The overall relationship is a positive one; as we move to the right (more positive change) along the X-axis, the cluster of scores moves up (more positive change) on the Y-axis. Though ACT scores have experienced a decline, schools that have experienced higher gains on the KCCT tend to have smaller losses, or to have gained, on the ACT. This allows the positive correlation to emerge.

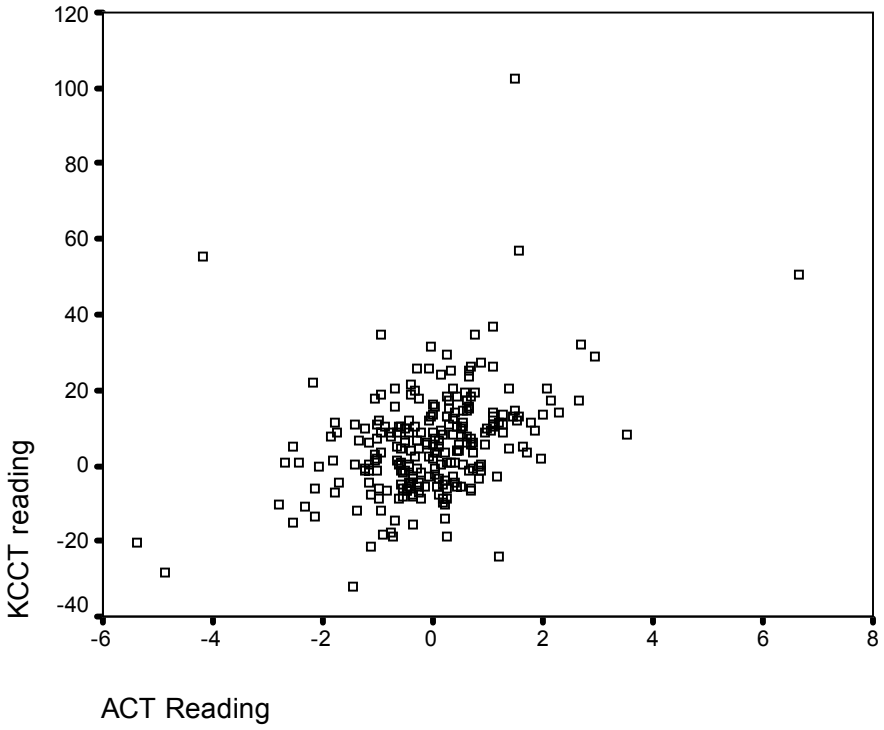


Figure 1. Changes in KCCT Reading and ACT Reading from graduation years 2001 to 2002.

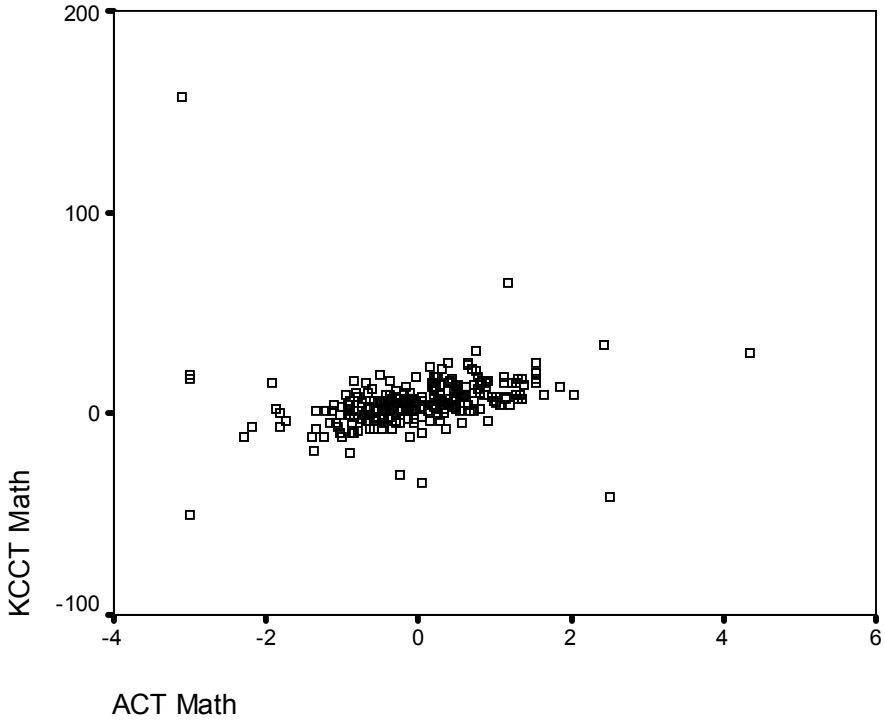


Figure 2. Changes in KCCT Math and ACT Math from graduation years 2000 to 2002**.**

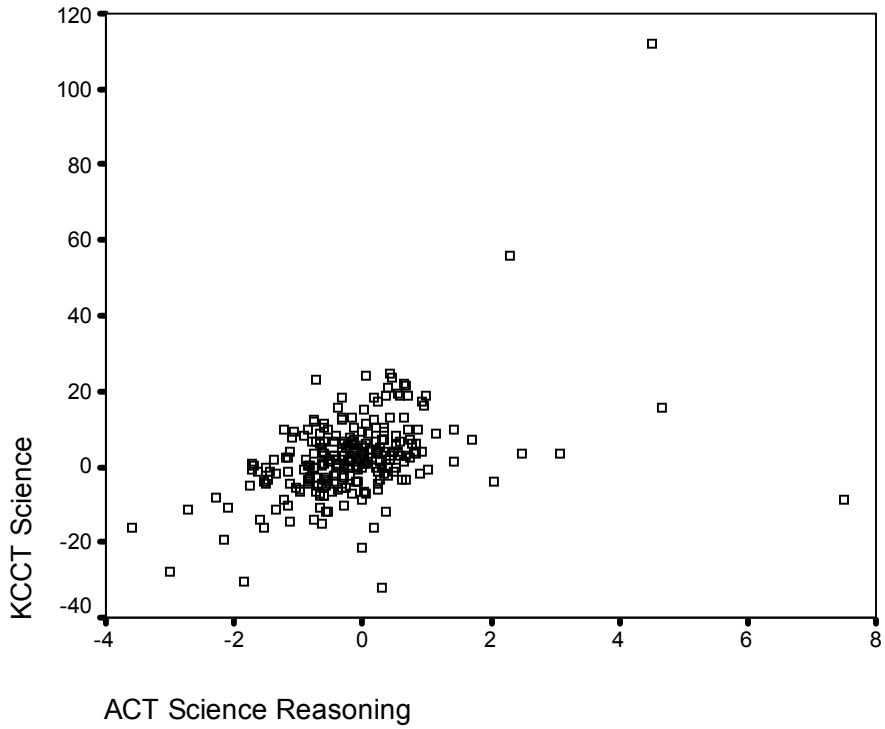


Figure 3. Changes in KCCT Science and ACT Science Reasoning from graduation years 2000 to 2002.

Figures 4-6 depict scatterplots of gain scores for KCCT and ACT. Those plots indicate an overall trend for school gains to be in the same direction for both KCCT and ACT. Despite an overall decline in ACT scores and an improvement in KCCT scores, we can be assured that successful school-level preparation for one type of exam does not produce a decline in scores on the other. Any large changes (over 100 scale score points) in mean KCCT scale scores are primarily due to very small sample sizes. All schools with changes of over 100 scale score points had no more than two students in a grade during at least one of the testing years.

Relationships among Measures of Student-Level Scores

This section presents relationships among KCCT and the other measures of student achievement in several ways.

Illustrations of Relationships

Figures 4 through 13 present box plots that illustrate relationships between KCCT scores and other measures of student achievement, combining students from all three graduation years. The boxes and whiskers in each plot represent the distribution of KCCT scores for varying levels of ACT scores, student grades, and number of relevant courses taken in high school. Each box represents 50% of the students within each of the categories along the X-axis. The median is represented by the line in the middle of the box. The whiskers represent the spread of the distribution of students calculated as 1.5 times the length of the box. This spread should include approximately 99.3% of all students for the given category. Sample sizes within each category along the X-axis are noted. ACT score intervals used in these figures reflect intervals used by ACT in its score reporting (ACT, 2001).

Figures 4-6 present a consistent pattern. Students with higher ACT scores tend to have higher KCCT scale scores. Increasingly higher ACT scores are associated with increasingly higher KCCT scores.

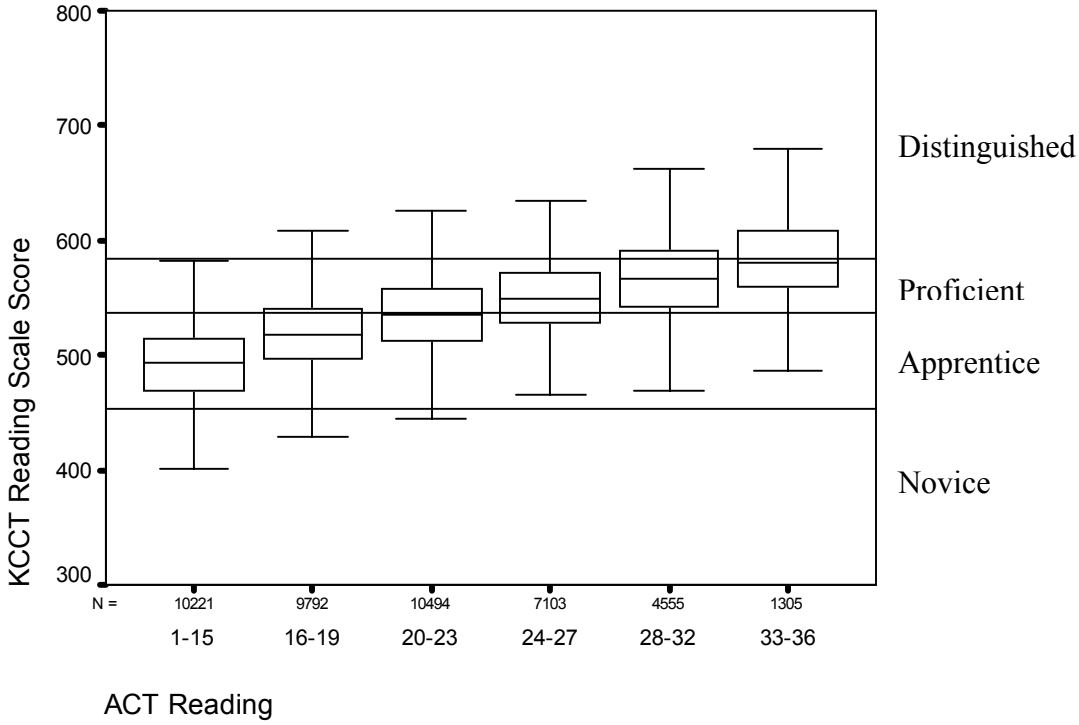


Figure 4. Student-level relationship between KCCT Reading scale score and ACT Reading score for graduation years 2001 through 2002.

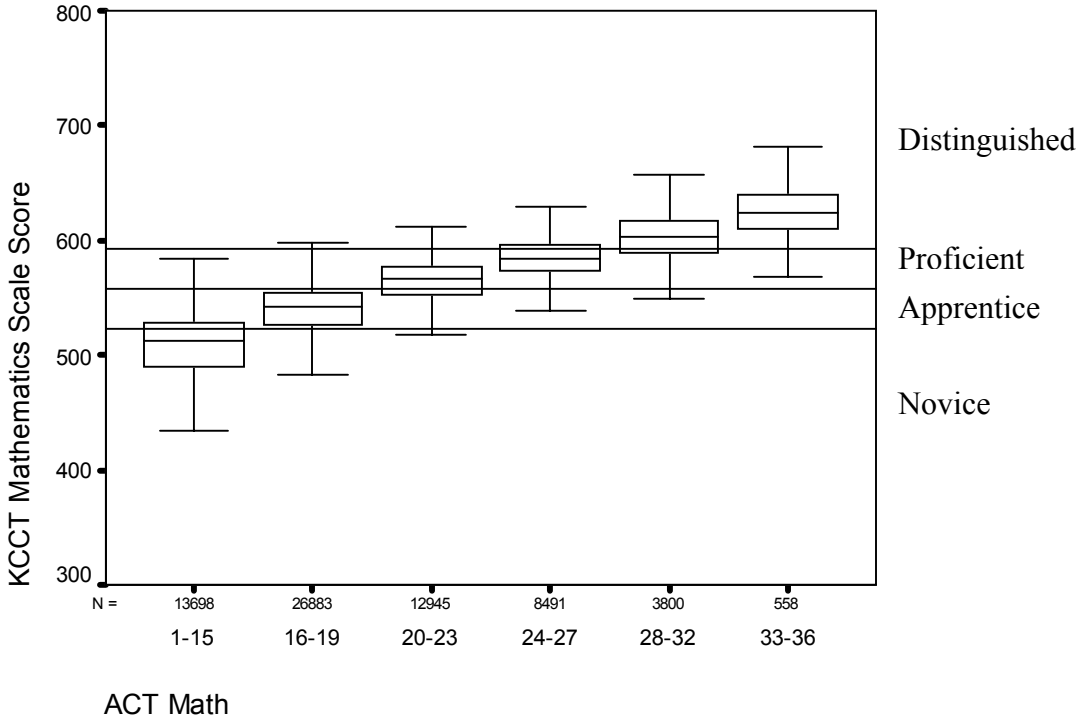


Figure 5. Student-level relationship between KCCT Math scale score and ACT Math score for graduation years 2000 through 2002.

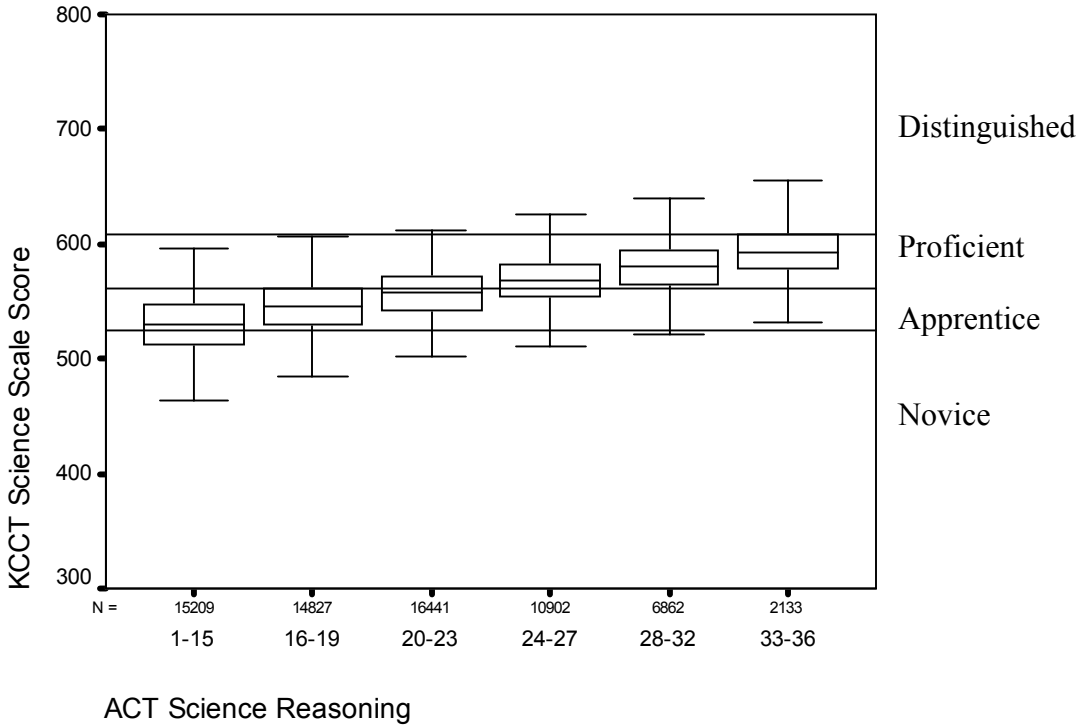


Figure 6. Student-level relationship between KCCT Science scale score and ACT Science Reasoning score for graduation years 2000 through 2002.

Figures 7 through 13 illustrate relationships between grade point averages and KCCT scores. Grade point averages for each subject were computed from the students' self-reported scores for courses within that subject. The use of self-reported data undoubtedly involves some inaccuracies; however, Cassady found students' self-reported grades to be a reliable measure of actual grades (Cassady, 2001). These self-reported grades were measured categorically (F=0, D=1, C=2, B=3 and A=4); therefore, interpretations of overall GPA for each subject should be made cautiously. For example, 12221 students reported receiving an 'A' in Algebra 1, Algebra 2, and Geometry, resulting in an overall math GPA calculated to be 4.0. In these cases, however, a 4.0 math grade point average is not a "perfect" score. Since most students would take the ACT late in their junior year or during their senior year, only the courses in each subject that would normally be taken through the junior year were included in the computations. Thus, three courses were included for English —English 9, English 10, and English 11. For mathematics, three courses were included—Algebra I, Geometry, and Algebra II. For science, two courses were included—Biology and Chemistry. For social studies, two courses were included—U.S. History and World History. This method of computing student GPA differs from that of Hoffman (1998) in that only certain courses were used. GPA, as reported by Hoffman, included social studies electives and upper level math courses that were omitted from the current GPA calculation. By restricting reported grades to courses that most high school students would take by their junior year, we can compare student grades for the same courses. The subject-specific grade point averages and KCCT relationships are consistent with expectations. Overall, students with higher grade point averages tend to have higher KCCT scale scores. Note, however, that the medians suggest that there is not much difference between *D* and *D*+ students on KCCT Reading. Clearer differences in KCCT scores are observable through the range of *C* to *A* students in Reading. The pattern is more linear throughout the scale for math, science, and social studies. This pattern is similar to those presented by Hoffman's previous work.

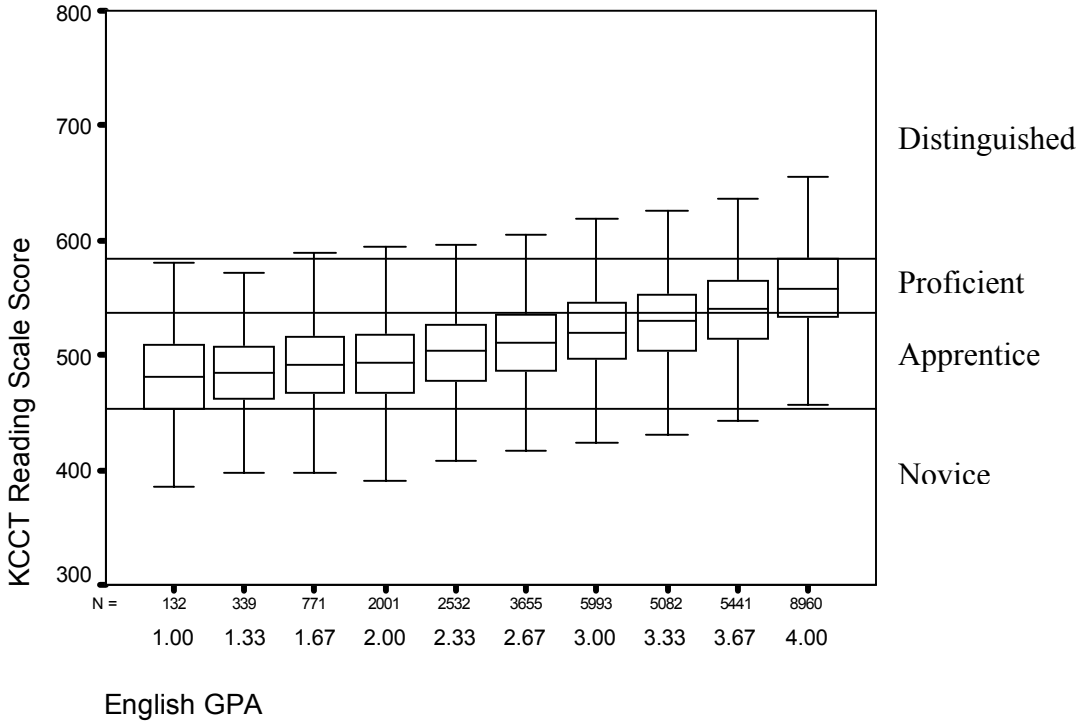


Figure 7. Student-level relationship between KCCT Reading scale score and English GPA for graduation years 2001through 2002.

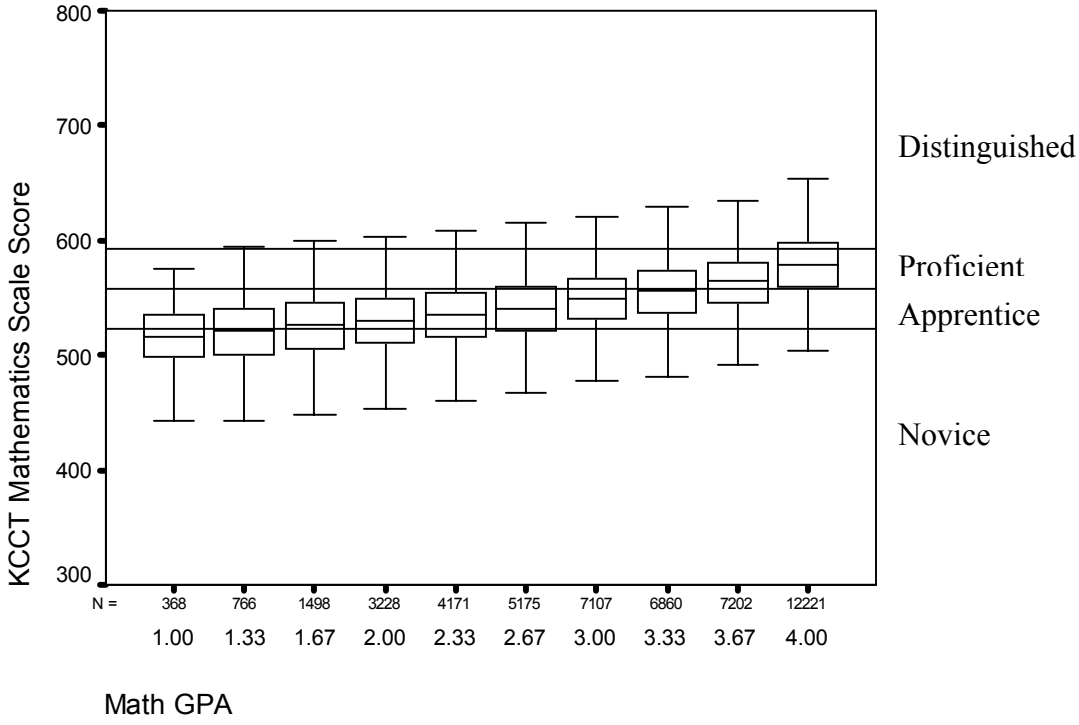


Figure 8. Student-level relationship between KCCT Math scale score and math GPA for graduation years 2000 through 2002.

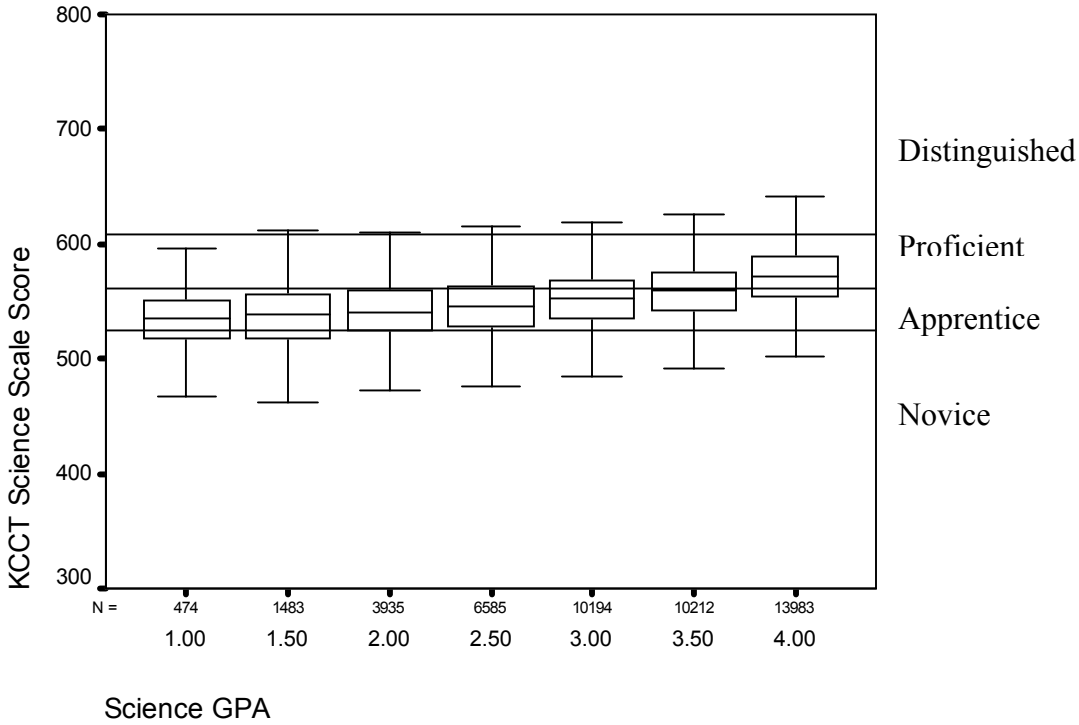


Figure 9. Student-level relationship between KCCT Science scale score and science GPA for graduation years 2000 through 2002.

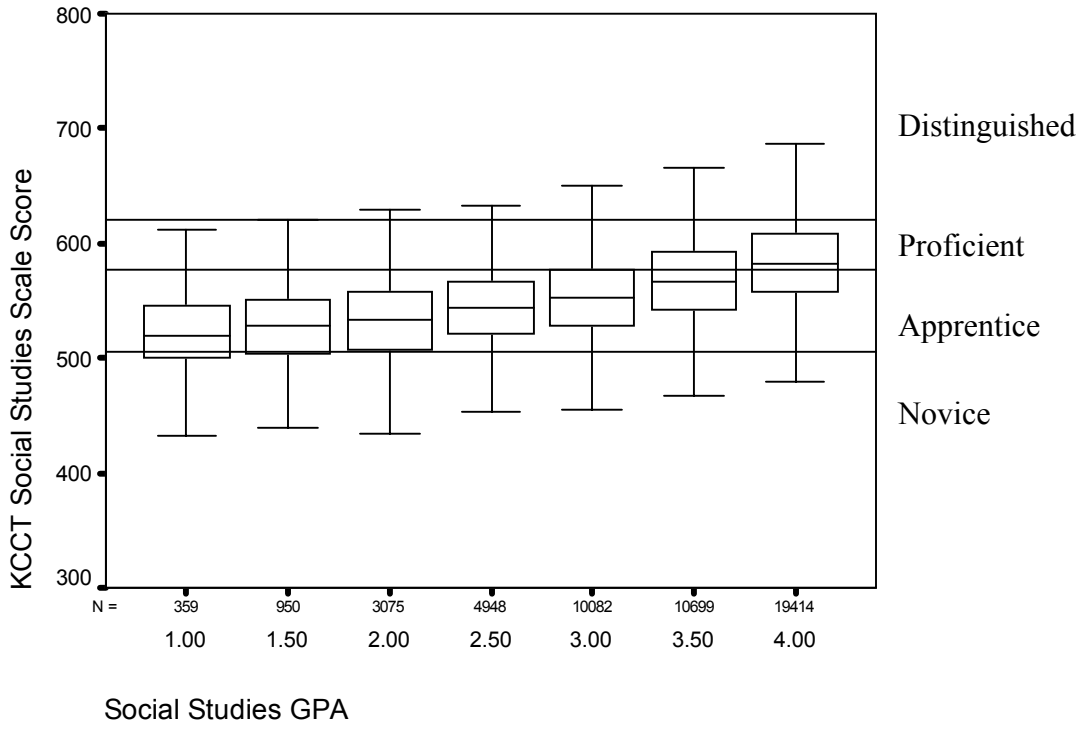


Figure 10. Student-level relationship between KCCT Social Studies scale score and social studies GPA for graduation years 2000 through 2002.

In the ACT's student profile section, students are asked to indicate from a list of courses provided (see Table 14) the courses they have taken or plan to take prior to graduation. The courses students are to choose from are those that students in a college preparatory class are likely to take during their high school years. These are the courses the ACT consider "core" courses (ACT 2002). Note that the science and especially the math courses listed in Table 14 represent what might be considered a progression of courses. In other words, the courses listed are typically taken by students in order, and therefore the number of courses taken in those subjects represent the progress the student has made in that field. Each subsequent course tends to build on knowledge from the previous course and is required for success in the next. The social studies courses do not represent such a progression and might be taken in any order by a student.

Table 14. Course Titles Listed on ACT Student Questionnaire

Math	Science	Social Studies
First-year Algebra	General/Physical/Earth science	U.S. History
Second-year Algebra	Biology	World History
Geometry	Chemistry	Other History
Trigonometry	Physics	American Government/Civics
Calculus		Economics
Other math beyond Algebra II		Geography
		Psychology

The number of courses completed or in progress during KCCT testing was tallied as another index of student achievement. Computation of the number of courses taken was somewhat complicated by the fact that students took the ACT at different times, frequently as early as their junior year. Therefore, *completed* courses were defined to include courses reported as *have taken* plus courses reported as *planning to take*.

Figures 11 through 13 present relationships between numbers of courses taken in each subject and corresponding KCCT scores. The patterns vary by content area, both in terms of the associations with KCCT scores and numbers of students who fall in each of the respective categories. In terms of English courses (boxplot not presented here), no discernible pattern exists between number of courses and KCCT Reading score. Of course, this is expected when it is taken into consideration that an overwhelming majority of students (99.9%) report taking four English classes. On the other hand, students report a wide range in numbers of classes taken in mathematics and social studies. For mathematics, students who take more classes also score higher on the Mathematics portion of the KCCT. For social studies, the association suggests that students who take between five and six classes (taking at least three social studies classes is recommended as part of the ACT's "core" program (ACT, 2002)) have slightly higher KCCT Social Studies scores. Students who take fewer or more social studies classes tend to have slightly lower KCCT scores. Number of science classes exhibits a pattern similar to mathematics. Students taking more science courses tended to score higher on the science portion of the KCCT.

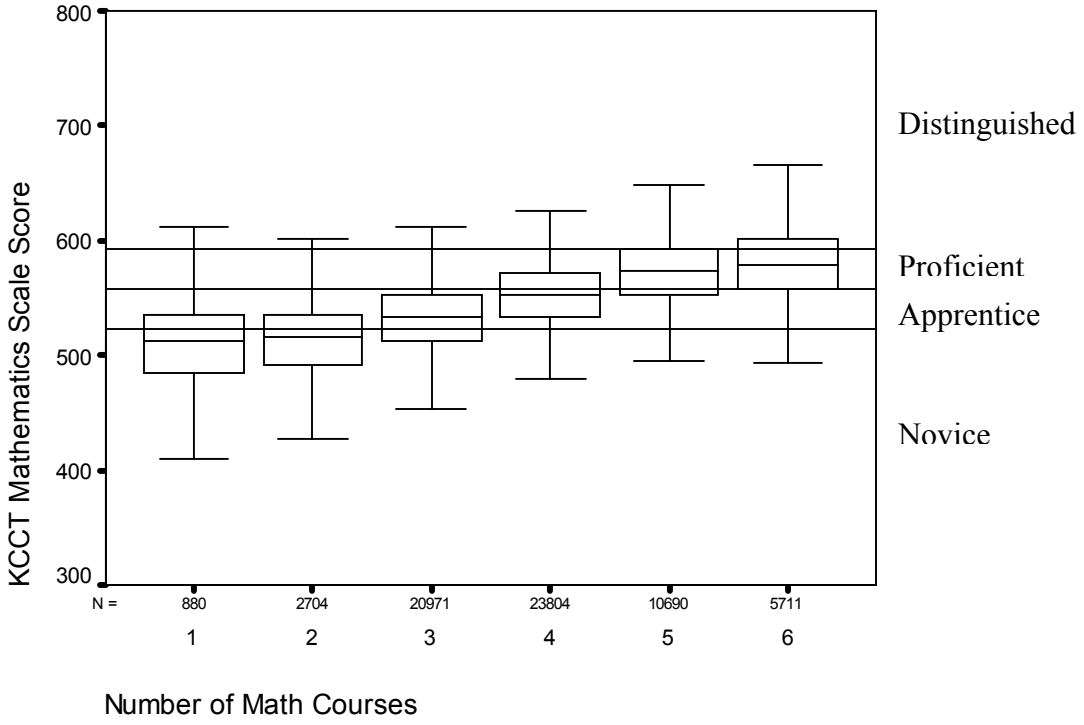


Figure 11. Student-level relationship between KCCT Math scale score and number of math courses taken for graduation years 2000 through 2002.

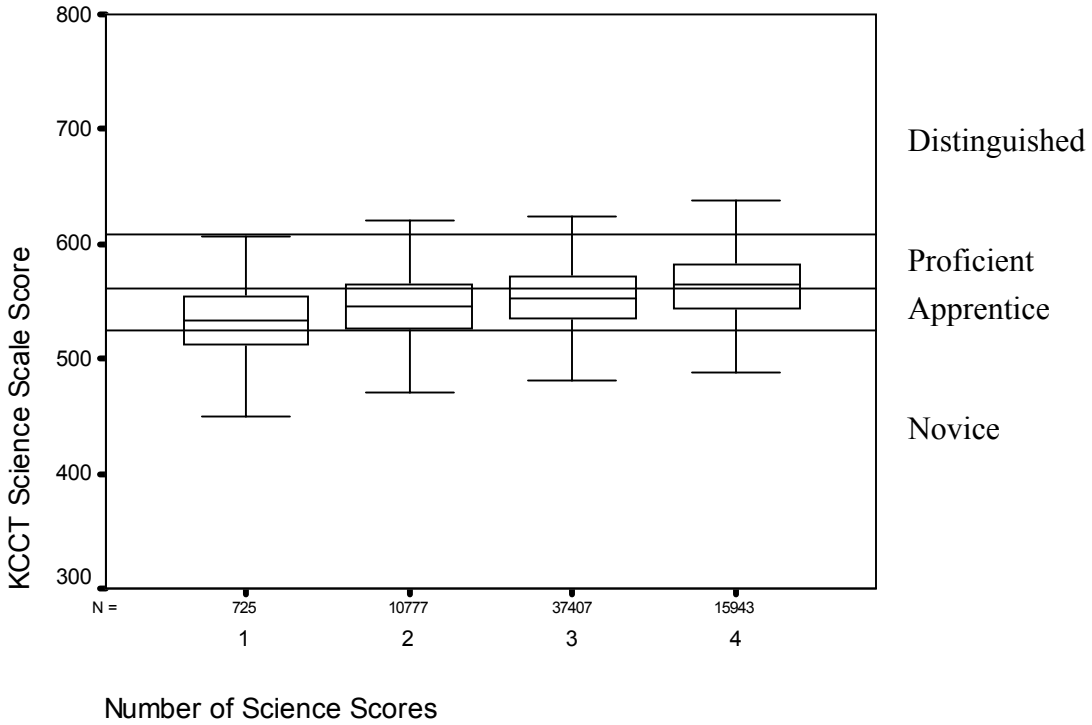


Figure 12. Student-level relationship between KCCT Science scale score and number of science courses taken for graduation years 2000 through 2002.

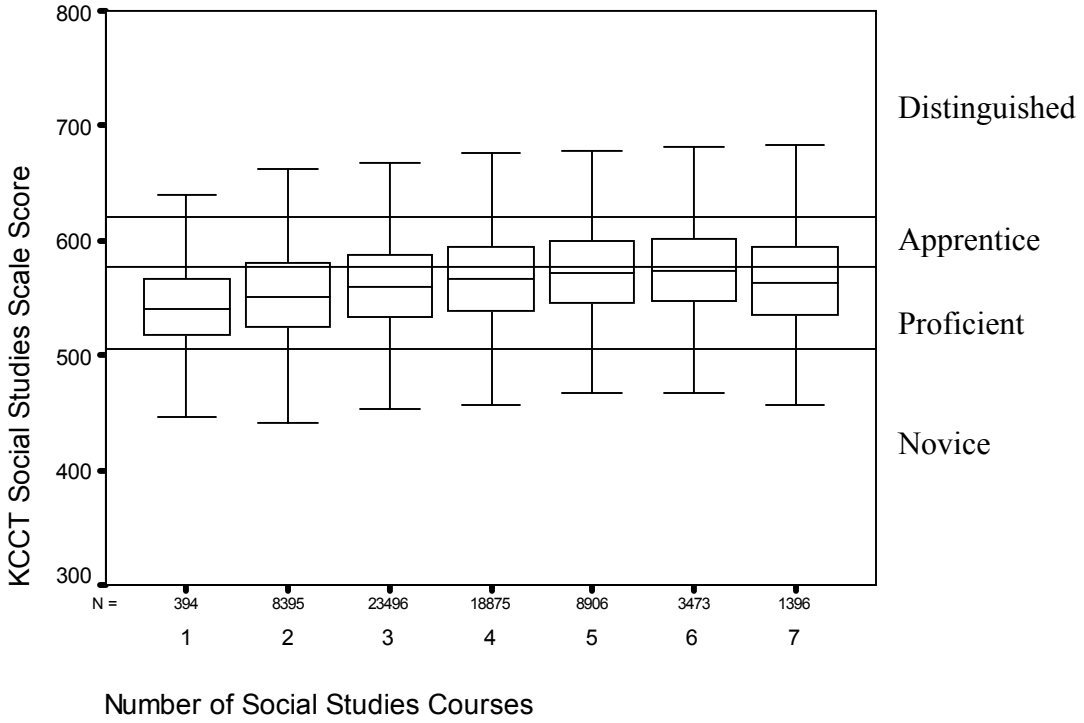


Figure 13. Student-level relationship between KCCT Social Studies scale score and number of social studies courses taken for graduation years 2000 through 2002.

Correlations Among Student-Level Measures[1]

Table 15 presents correlations among KCCT, ACT, and GPA computed for all students from all three years. The table differentiates between the correlations among the content areas within each of the different assessments from the correlations between the different kinds of assessments (Campbell & Fiske, 1959), thus allowing for the examination of the following relationships:

- The same content area within different achievement measures, or convergent validity coefficients (Campbell & Fiske, 1959). (These correlations are in bold and are underlined.)
- Different content areas within the same achievement measures. (These correlations are in italics.)
- Different content areas within different achievement measures. (These correlations are in bold, but not underlined.)

In correlation tables of this type, the expectation is for the highest correlations to be between different measures of the same content. Then, because of similarities in test-taking strategies or other method effects, the next highest correlations are typically those between different content, but measured by the same method of assessment. Correlations between different content areas with different measures should be the lowest in the table.

[1] Given the extremely large sample sizes used in this report, tests of statistical significance are irrelevant. All reported relationships are statistically significant; that is, unlikely to be due to chance. Therefore, the report focuses on interpretation of the results.

As Table 15 shows, all correlations are positive and above .30. This means that students who do well on any one measure of any content also tend to do well on all measures and in all content areas. In a recent study of school-level assessment scores, Sicoly discusses the existence of a general cognitive factor that "cuts across content areas" (Sicoly, 2002). If such a "g-factor" exists, then it would be expected that students with high ability would score well on any test, regardless of the content. Correlations presented in Table 13 suggest that Kentucky students who exhibit high ability in one content area can be expected to perform well in other content areas.

Interestingly, the highest correlations in the table are not between different measures of the same content. Instead, the highest correlations are between the different content areas within a given measure, with ACT intercorrelations being the highest. Disregarding the correlations for the ACT composite (which is calculated from the four ACT content measures), the ACT intercorrelations range from .63 to .78. Generally academic achievement is perceived to be influenced by a strong general tendency to do well or poorly on a given subject. The pattern exhibited here supports common expectations that, for example, English and reading skills are more highly related with each other (.78) than either is with mathematics (.72 and .63). Science Reasoning falls somewhere in between, with correlations with English, Reading, and Mathematics that are .72 to .74.

In contrast to ACT, the KCCT assessments show lower intercorrelations. The correlations between Practical Living items and other KCCT items (with the exception of reading) are lower than the other KCCT intercorrelations (.44 to .50). The Practical Living portion of the KCCT is administered at the 10th grade level, along with Reading. This suggests that some year-to-year differences in students' scores might be at work. However, the correlation between Reading and Math, for example, is higher than that between Math and Arts & Humanities, which is administered at the same grade level as the Math assessment. Rather than year-to-year differences, it appears that correlations among student-level scores are more related to whether or not a particular subject can be considered a "core" subject.

In reference to correlations between measures, note that the correlations between KCCT assessments and ACT scales are roughly the same magnitude as the KCCT intercorrelations (with the exception of Arts & Humanities and Practical Living). The mathematics correlation between KCCT and ACT however, does appear to be an exception. There seems to be a higher degree of convergent validity among mathematics scores.

Note also that there may be content coverage differences between ACT and KCCT that are depressing the correlations between ACT and KCCT measures of the same content areas. For example, the correlation between ACT Science Reasoning and KCCT Math (.65) is higher than the correlation between ACT Science Reasoning and KCCT Science (.61).

Lastly, it should be mentioned that these correlations represent the degree to which the measures are similar as well as the degree to which they are different. Two separate tests cannot correlate perfectly because the relationship is affected by error variance. Error variance is often represented by Cronbach's alpha (A high alpha statistic represents high internal consistency reliability, and low error variance). This statistic is affected to a large extent by the number of items on the test. Each ACT component has about 10 more items that KCCT Math, Reading, Science, or Social Studies. Arts & Humanities and Practical Living/Vocational Studies have

fewer than half the number of items included on an ACT component. Therefore, simply by virtue of having more items, we would expect ACT to have larger intercorrelations than KCCT. We might also expect the correlations between KCCT and ACT to be lower than would be expected if both tests included the same higher number of items. This is especially true of Arts & Humanities and Practical Living/Vocational Studies.

The pattern of association for GPA with KCCT and ACT scores follows a similar pattern and does not show substantially stronger correlations between like-content areas than between unlike-content areas. For example, science GPA correlates with KCCT Reading, Math, and Social Studies at essentially the same magnitude as with KCCT Science (.37 to .41). For the ACT and GPA correlations, ACT Science Reasoning and science GPA correlate .40. In comparison, science GPA and ACT Math correlate .44, while science GPA correlates with ACT English .43.

Math, however, does show a somewhat more expected pattern within both the correlations between GPA and KCCT and the correlations between GPA and ACT. The correlation between math GPA and Math KCCT (.53) is higher than any of the other correlations between GPA and KCCT that involve either of the two math measures. The margin of the difference is from .05 (the difference from the correlation between KCCT Reading and math GPA) to .17 (the difference from the correlation between Practical Living KCCT and math GPA). Likewise, the correlation between math GPA and Math ACT (.53) is higher than any of the other correlations between GPA and ACT that involve either of the two math measures. The margins for these differences range from .08 for the difference between Math GPA and English ACT to .17 for the correlation between math GPA and ACT Reading.

All in all, Table 15 shows an overall pattern of similar performance among KCCT, ACT, and GPA, but little evidence that the measures are tapping much that is unique with regard to differences among content areas. High ability students tend to do well on all KCCT items and on all ACT scales, and to have high GPAs in all subjects. With the possible exception of mathematics, the correlations do not suggest that students who do well in a particular subject on one type of assessment will have higher scores in that subject for other types of assessments than they will for any measure of any subject.

Hoffman's (1998) correlation data relating KIRIS open-response items to ACT is presented in Table 14 for comparison. The relationships between KIRIS open-response items and ACT are very similar to those between KCCT and ACT. The comparison of the two sets of results indicates that KIRIS, KCCT, and ACT scores all seem to be related to the content areas in much the same manner. There is no indication that KCCT represents a content domain that is either more similar or more divergent from ACT than KIRIS.

Table 15. Correlations Among KCCT, ACT and Grade Point Averages for Graduation Years 2000 through 2002

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
KCCT															
1. Reading*	*1.00*														
2. Math	*.57*	*1.00*													
3. Science	*.57*	*.67*	*1.00*												
4. Social Studies	*.65*	*.62*	*.68*	*1.00*											
5. Arts & Humanities	*.57*	*.50*	*.54*	*.64*	*1.00*										
6. Practical Living*	*.57*	*.44*	*.45*	*.50*	*.43*	*1.00*									
ACT															
7. English	**.65**	**.65**	**.61**	**.63**	**.54**	**.50**	*1.00*								
8. Reading	**.59**	**.57**	**.58**	**.60**	**.48**	**.45**	*.78*	*1.00*							
9. Math	**.53**	**.75**	**.60**	**.56**	**.45**	**.41**	*.72*	*.63*	*1.00*						
10. Science Reasoning	**.54**	**.65**	**.61**	**.56**	**.45**	**.42**	*.72*	*.72*	*.74*	*1.00*					
11. Composite	**.65**	**.73**	**.67**	**.66**	**.54**	**.50**	*.91*	*.89*	*.86*	*.88*	*1.00*				
GPA															
12. English	**.48**	**.40**	**.38**	**.44**	**.38**	**.36**	**.48**	**.42**	**.41**	**.39**	**.48**	*1.00*			
13. Math	**.48**	**.53**	**.36**	**.43**	**.38**	**.36**	**.45**	**.36**	**.53**	**.43**	**.49**	*.61*	*1.00*		
14. Science	**.41**	**.41**	**.37**	**.38**	**.32**	**.31**	**.43**	**.37**	**.44**	**.40**	**.46**	*.64*	*.64*	*1.00*	
15. Social Studies	**.42**	**.37**	**.37**	**.41**	**.33**	**.32**	**.43**	**.38**	**.38**	**.37**	**.44**	*.65*	*.55*	*.58*	*1.00*

*KCCT was changed in 1999. Tests given prior to 1999 were not used for this analysis. KCCT Reading and Practical Living scores not available for the class of 2000

Table 16. Open Response, ACT, and Grade Point Average (GPA) Correlations for Students From 1993-94 Through 1995-96

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Open Response															
1. Reading	*1.00*														
2. Math	*0.54*	*1.00*													
3. Science	*0.59*	*0.64*	*1.00*												
4. Social Studies	*0.59*	*0.55*	*0.61*	*1.00*											
5. Writing Prompt	*0.38*	*0.31*	*0.34*	*0.38*	*1.00*										
ACT															
6. English	**0.56**	**0.61**	**0.57**	**0.54**	**0.42**	*1.00*									
7. Reading	**0.52**	**0.54**	**0.54**	**0.52**	**0.35**	*0.80*	*1.00*								
8. Math	**0.44**	**0.72**	**0.54**	**0.47**	**0.33**	*0.69*	*0.62*	*1.00*							
9. Science	**0.47**	**0.63**	**0.57**	**0.50**	**0.34**	*0.74*	*0.74*	*0.73*	*1.00*						
Reasoning															
10. Composite	**0.56**	**0.70**	**0.62**	**0.57**	**0.41**	*0.91*	*0.90*	*0.84*	*0.89*	*1.00*					
GPA															
11. English	**0.38**	**0.36**	**0.35**	**0.34**	**0.25**	**0.42**	**0.37**	**0.35**	**0.34**	**0.42**	*1.00*				
12. Math	**0.32**	**0.45**	**0.36**	**0.30**	**0.20**	**0.39**	**0.32**	**0.48**	**0.38**	**0.43**	*0.53*	*1.00*			
13. Science	**0.35**	**0.41**	**0.37**	**0.32**	**0.21**	**0.40**	**0.35**	**0.42**	**0.38**	**0.43**	*0.57*	*0.56*	*1.00*		
14. Social Studies	**0.35**	**0.35**	**0.35**	**0.34**	**0.22**	**0.39**	**0.36**	**0.35**	**0.35**	**0.41**	*0.57*	*0.48*	*0.53*	*1.00*	
15. High School	**0.43**	**0.49**	**0.44**	**0.40**	**0.27**	**0.49**	**0.43**	**0.49**	**0.44**	**0.52**	*0.82*	*0.80*	*0.81*	*0.77*	*1.00*

Another way of considering student-level ACT-KCCT comparisons uses the familiar percentile rankings ACT reports for each student. The percentile rankings allow students to quickly determine how well they've scored compared to the national population of ACT-taking students. ACT reports percentile rankings for each subject tested as well as for the composite. Tables 17-19 contain ACT data percentiles and their associated scale scores. The data were divided into deciles to make interpretation easier; however, ACT scores range from 1 to 36 and the number of students represented by each scale point varies substantially, consequently splitting the data into deciles was not exact. The percentage of students represented in each cell is provided in addition to target deciles. For instance, the percentile range from 90-99 could include ACT scores from 29-36, but a score of 28 might only place students in the 86th percentile. In that case, the range of scores from 29-36 would actually be the top 14% of students despite our attempts to represent only the top 10%. This phenomenon is further complicated by the fact that the relationship between percentiles and ACT scale scores changes from year to year. In order to represent the data as correctly as possible, actual percentages are presented for each reported year in Tables 17-19.

Despite the complexity of the ACT percentile data, comparisons between the national population of students and Kentucky students are straightforward. One need only look at the differences between the national percentiles and the percentage of Kentucky students scoring within the same range to see how Kentucky compares to the rest of the nation at any point along the distribution of ACT scores.

Mean KCCT scores are presented in the tables as well. KCCT means are calculated from students scoring in the actual ACT interval presented rather than from the target deciles, to make the within year comparisons more accurate. Because the data from year to year does not represent exactly the same proportion of students, either nationally or in Kentucky, comparisons should not be made between years from these tables. Consistent with the data presented in the box plot figures and the tables of correlations, the mean KCCT scores increase as the ACT scores increase.

Tables 17-19 include subject-specific information. Table 20 contains composite ACT scores. A composite KCCT score was calculated for comparison. The composite KCCT score averages students' results for math, science, and reading. Only the class of 2001 and 2002 are presented since students take the reading test in 10th grade and that data was not available for the class of 2000.

Table 17. Proportion of Kentucky Students and Mean KCCT Math Scores Within ACT Math Percentile Rankings by Graduation Year

ACT Percentile Ranking	National Percentile	Actual ACT Score	Number of KY students	Mean KCCT Math	National Percentile	Actual ACT Score	Number of KY students	Mean KCCT Math	National Percentile	Actual ACT Score	Number of KY students	Mean KCCT Math
	Graduating Class of 2000				**Graduating Class of 2001**				**Graduating Class of 2002**			
90-99	90-99		1441	603.38	90-99		1419	608.68	90-99		1461	610.95
10%	10%		7%		10%		7%		10%		6%	
80-89	77-89		1916	584.17	80-89		1931	587.10	77-89		2173	589.00
10%	13%		9%		10%		9%		13%		10%	
70-79	67-76		1586	573.61	67-79		1612	573.91	67-76		1807	576.31
10%	10%		7%		13%		8%		10%		8%	
60-69	56-66		2116	564.24	56-66		1973	565.08	57-66		2159	566.23
10%	11%		10%		11%		9%		10%		9%	
50-59	49-55		1163	558.06	49-55		1410	558.64	44-56		3013	557.55
10%	7%		5%		7%		7%		13%		13%	
40-49	40-48		4188	546.18	41-48		3671	547.31	35-43		2255	548.01
10%	9%		19%		8%		18%		9%		10%	
30-39	31-39		2562	533.97	32-40		2400	535.88	26-34		2546	539.50
10%	9%		12%		9%		12%		9%		11%	
20-29	22-30		2441	523.29	22-31		2320	526.69	17-25		2703	529.23
10%	9%		11%		10%		11%		9%		12%	
10-19	8-21		2373	511.95	8-21		1969	512.69	9-16		2295	516.50
10%	14%		11%		14%		9%		8%		10%	
0-9	0-7		2212	490.75	0-7		2220	495.68	0-8		2526	501.60
10%	8%		10%		8%		11%		9%		11%	

Table 18. Proportion of Kentucky Students and Mean KCCT Science Scores Within ACT Science Reasoning Percentile Rankings by Graduation Year

ACT Percentile Ranking	National Percentile	Actual ACT Score	Number of KY students	Mean KCCT Science	National Percentile	Actual ACT Score	Number of KY students	Mean KCCT Science	National Percentile	Actual ACT Score	Number of KY students	Mean KCCT Science
	Graduating Class of 2000				**Graduating Class of 2001**				**Graduating Class of 2002**			
90-99 10%	90-99 10%	27-36	1603 7%	587.60	89-99 11%	27-36	1800 9%	590.82	90-99 10%	27-36	1746 8%	592.18
80-89 10%	80-89 10%	25-26	1696 8%	575.82	79-88 10%	25-26	1771 9%	577.16	75-89 15%	24-26	2769 12%	576.43
70-79 10%	65-79 15%	23-24	2870 13%	568.38	66-78 13%	23-24	2414 12%	569.54	67-74 8%	23	1681 7%	568.83
60-69 10%	56-64 9%	22	2025 9%	560.06	57-65 9%	22	1440 7%	563.62	58-66 9%	22	1990 9%	562.54
50-59 10%	49-55 7%	21	1580 7%	555.04	49-56 8%	21	1906 9%	557.39	42-57 16%	20-21	3846 17%	556.34
40-49 10%	38-48 11%	20	2280 10%	551.03	49-48 10%	20	2184 10%	553.36	32-41 10%	19	2716 12%	550.37
30-39 10%	30-37 8%	18-19	4304 20%	543.92	22-38 17%	18-19	3972 19%	545.38	23-31 9%	18	2415 11%	543.59
20-29 10%	22-29 8%	17	1681 8%	533.88	16-21 6%	17	1628 8%	537.32	17-22 6%	17	1589 7%	536.15
10-19 10%	8-21 14%	15-16	2161 10%	528.77	8-15 8%	15-16	2048 10%	529.95	10-16 7%	15-16	2201 10%	531.03
0-9 10%	0-7 8%	0-14	1796 8%	518.78	0-7 8%	0-14	1762 8%	519.65	0-9 10%	0-14	1985 9%	520.12

Table 19. Proportion of Kentucky Students and Mean KCCT Reading Scores Within ACT Reading Percentile Rankings by Graduation Year

ACT Percentile Ranking	National Percentile	Actual ACT Score	Number of KY students	Mean KCCT Reading	National Percentile	Actual ACT Score	Number of KY students	Mean KCCT Reading
	Graduating Class of 2001				**Graduating Class of 2002**			
90-99 10%	90-99 10%	30-36	1705 8%	573.43	88-99 12%	29-36	2347 10%	579.20
80-89 10%	80-89 10%	27-29	1918 9%	557.34	75-87 13%	26-28	2566 11%	560.71
70-79 10%	66-79 14%	24-26	2634 13%	545.59	70-74 5%	25	964 4%	549.60
60-69 10%	60-65 6%	23	1208 6%	539.00	55-69 15%	22-24	3597 16%	544.14
50-59 10%	48-59 12%	21-22	2602 12%	531.84	48-54 7%	21	1538 7%	534.78
40-49 10%	36-47 12%	19-20	2550 12%	524.75	38-47 10%	19-20	2641 12%	528.22
30-39 10%	30-35 6%	18	1320 6%	517.65	27-37 11%	17-18	2744 12%	520.09
20-29 10%	16-29 14%	15-17	3297 16%	506.79	18-26 9%	15-16	2617 11%	508.35
10-19 10%	7-15 9%	13-14	2373 11%	491.31	8-17 10%	13-14	2383 10%	495.42
0-9 10%	0-6 7%	0-12	1318 6%	475.92	0-7 8%	0-12	1541 7%	479.84

Table 20. Proportion of Kentucky Students and Mean KCCT Composite Scores Within ACT Composite Percentile Rankings by Graduation Year

ACT Percentile Ranking	National Percentile	Actual ACT Score	Number of KY students	Mean KCCT Composite	National Percentile	Actual ACT Score	Number of KY students	Mean KCCT Composite
	Graduating Class of 2001				**Graduating Class of 2002**			
90-99	87-99 13%	27-36	2121 10%	588.83	88-99 12%	27-36	2131 9%	593.84
80-89	77-86 10%	25-26	1609 8%	572.34	78-87 10%	25-26	1727 8%	576.55
70-79	65-76 12%	23-24	2247 11%	563.13	66-77 12%	23-24	2411 11%	566.23
60-69	57-64 8%	22	1378 7%	555.60	59-65 7%	22	1505 7%	559.67
50-59	49-56 8%	21	1610 8%	549.85	43-58 16%	20-21	3604 16%	550.84
40-49	34-48 15%	19-20	3519 17%	541.69	36-42 7%	19	2063 9%	542.85
30-39	26-33 8%	18	1784 9%	532.74	28-35 8%	18	1984 9%	536.14
20-29	19-25 7%	17	1755 8%	525.90	15-27 13%	16-17	3533 15%	526.53
10-19	9-18 10%	15-16	2783 13%	516.26	10-14 5%	15	1544 7%	514.00
0-9	0-8 9%	0-14	2119 10%	495.09	0-9 10%	0-14	2436 11%	497.41

It is clear from Tables 17-20 that the distribution of Kentucky students' scores on the ACT scale is very similar to the distribution of students nationally. The proportion of Kentucky students scoring at the very top of the distribution tends to be somewhat smaller than would be expected from the national data, especially in mathematics. Kentucky also tends to have a somewhat larger than expected proportion of students scoring in the lowest percentiles. However, the differences are small. Given that nearly all postsecondary education opportunities in Kentucky require that students take the ACT, this data is not surprising. There is no indication that preparation for KCCT is causing the distribution of ACT scores to become skewed in either direction.

In order to compare percentile rankings across the three graduation years, 2001 and 2002 data were recalculated, using the ACT percentiles and their associated scale scores from 2000 (for Reading and English, 2002 data were recalculated using scale scores ranges from the ACT 2001 percentiles). Tables 21-24 present these findings. The first column of each table contains the target ACT deciles. The second column presents the ACT scale score range that was contained in each decile for the year 2000 (or 2001 for Reading and English). These values were held constant when recalculating data from the subsequent years. The third, sixth and ninth columns of each table contain the National percentage of students represented in each decile for each year based on the 2000 (or 2001) scale score ranges. The remaining columns present the proportion of Kentucky students within each decile and their coordinating mean KCCT scale score. The results are presented in Tables 21-24.

When the range of scale scores for each decile is held constant, the number of Kentucky students in each decile remains relatively constant over the three years. Kentucky students continue to have a smaller proportion of students at the top and a larger proportion of students at the bottom, when compared to national rankings. But, as stated before, these differences are slight. Steady gains in KCCT mean scores however, can be seen for the scope of Kentucky's ACT-taking students in all subject areas.

Table 21. Proportion of Kentucky Students and Mean KCCT Math Scores Within ACT Math Percentile Scale Score Ranges Held Constant from 2000-2002

ACT Percentile Ranking	ACT Scale Score Range	National Percentile	Number of KY students	Mean KCCT Math	National Percentile	Number of KY students	Mean KCCT Math	National Percentile	Number of KY students	Mean KCCT Math
		Graduating Class of 2000			**Graduating Class of 2001**			**Graduating Class of 2002**		
90-99		90-99	1441	603.38	90-99	1503	608.68	90-99	1461	610.95
10%	28-36	10%	7%		10%	7%		10%	6%	
80-89		77-89	1916	584.17	77-89	2060	587.10	77-89	2173	589.00
10%	25-27	13%	9%		13%	9%		13%	10%	
70-79		67-76	1586	573.61	67-76	1728	573.91	67-76	1807	576.31
10%	23-24	10%	7%		10%	8%		10%	8%	
60-69		56-66	2116	564.24	56-66	2128	565.08	57-66	2159	566.22
10%	21-22	11%	10%		11%	9%		10%	9%	
50-59		49-55	1163	558.06	49-55	1518	558.64	51-56	1385	561.42
10%	20	7%	5%		7%	7%		6%	6%	
40-49		40-48	4188	546.18	33-48	3952	547.31	35-50	3883	550.62
10%	18-19	9%	19%		16%	17%		16%	17%	
30-39		31-39	2562	533.97	23-32	2607	535.88	26-34	2546	539.50
10%	17	9%	12%		10%	12%		9%	11%	
20-29		22-30	2441	523.29	15-22	2525	526.69	17-25	2703	529.23
10%	16	9%	11%		8%	11%		9%	12%	
10-19		8-21	2373	511.95	8-14	2166	512.69	9-16	2295	516.50
10%	15	14%	11%		7%	10%		8%	10%	
0-9		0-7	2212	490.75	0-7	2499	495.68	0-8	2526	501.60
10%	0-14	8%	10%		8%	11%		9%	11%	

Table 22. Proportion of Kentucky Students and Mean KCCT Science Scores Within ACT Science Reasoning Percentile Scale Score Ranges Held Constant from 2000-2002

ACT Percentile Ranking	ACT Scale Score Range	National Percentile	Number of KY students	Mean KCCT Science	National Percentile	Number of KY students	Mean KCCT Science	National Percentile	Number of KY students	Mean KCCT Science
		Graduating Class of 2000			**Graduating Class of 2001**			**Graduating Class of 2002**		
90-99		90-99	1603	587.60	89-99	1907	590.82	90-99	1746	592.18
10%	28-36	10%	7%		11%	8%		10%	8%	
80-89		80-89	1696	575.82	79-88	1896	577.16	81-89	1683	578.59
10%	25-26	10%	8%		10%	8%		9%	7%	
70-79		65-79	2870	568.38	66-78	2599	569.54	67-80	2767	570.49
10%	23-24	15%	13%		13%	12%		14%	12%	
60-69		56-64	2025	560.06	57-65	1582	563.62	58-66	1990	562.54
10%	22	9%	9%		9%	7%		9%	9%	
50-59		49-55	1580	555.04	49-56	2062	557.39	52-57	1384	557.92
10%	21	7%	7%		8%	9%		6%	6%	
40-49		38-48	2280	551.03	39-48	2339	553.36	42-51	2462	555.46
10%	20	11%	10%		10%	10%		10%	11%	
30-39		30-37	4304	543.92	22-38	4281	545.38	23-41	5131	547.18
10%	18-19	8%	20%		17%	19%		19%	22%	
20-29		22-29	1681	533.88	16-21	1793	537.32	17-22	1589	536.15
10%	17	8%	8%		6%	8%		6%	7%	
10-19		8-21	2161	528.77	8-15	2234	529.95	10-16	2201	531.03
10%	15-16	14%	10%		8%	10%		7%	10%	
0-9		0-7	1796	518.78	0-7	1993	519.65	0-9	1985	520.12
10%	0-14	8%	8%		8%	9%		10%	9%	

Table 23. Proportion of Kentucky Students and Mean KCCT Reading Scores Within ACT Reading Percentile Scale Scores Ranges Held Constant From 2001-2002

ACT Percentile Ranking	ACT Scale Score Range	National Percentile	Number of KY students	Mean KCCT Reading	National Percentile	Number of KY students	Mean KCCT Reading
			Graduating Class of 2001			**Graduating Class of 2002**	
90-99		90-99	1705	573.43	91-99	1821	582.15
10%	30-36	10%	8%		9%	8%	
80-89		80-89	1918	557.34	81-90	1980	563.91
10%	27-29	10%	9%		10%	9%	
70-79		66-79	2634	545.59	66-80	3028	552.61
10%	24-26	14%	13%		15%	13%	
60-69		60-65	1208	539.00	61-65	1098	543.22
10%	23	6%	6%		5%	5%	
50-59		48-59	2602	531.84	48-60	3085	538.45
10%	21-22	12%	12%		13%	13%	
40-49		36-47	2550	524.75	38-47	2641	528.22
10%	19-20	12%	12%		10%	12%	
30-39		30-35	1320	517.65	33-37	1262	523.60
10%	18	6%	6%		5%	6%	
20-29		16-29	3297	506.79	18-32	4099	511.51
10%	15-17	14%	16%		15%	18%	
10-19		7-15	2373	491.31	8-17	2383	495.42
10%	13-14	9%	11%		10%	10%	
0-9		0-6	1318	475.92	0-7	1541	479.84
10%	0-12	7%	6%		8%	7%	

Table 24. Proportion of Kentucky Students and Mean KCCT Reading Scores Within ACT English Percentile Rankings Held Constant From 2001-2002

ACT Percentile Ranking	ACT Scale Score Range	National Percentile	Number of KY students	Mean KCCT Reading	National Percentile	Number of KY students	Mean KCCT Reading
		Graduating Class of 2001			**Graduating Class of 2002**		
90-99		89-99	2296	575.12	89-99	2130	585.47
10%	28-36	11%	10%		11%	9%	
80-89		77-88	2211	555.89	78-88	2244	565.00
10%	25-27	12%	10%		11%	10%	
70-79		66-76	2107	547.46	68-77	1949	553.97
10%	23-24	11%	9%		10%	9%	
60-69		59-65	1443	540.95	61-67	1321	546.50
10%	22	7%	6%		7%	6%	
50-59		46-58	2877	532.45	47-60	3180	538.10
10%	20-21	13%	13%		14%	14%	
40-49		38-45	1819	523.23	40-46	1671	531.91
10%	19	8%	8%		7%	7%	
30-39		26-37	2862	515.40	28-39	2902	523.02
10%	17-18	12%	13%		12%	13%	
20-29		16-25	2700	504.64	17-27	2987	510.11
10%	15-16	10%	12%		11%	13%	
10-19		9-15	1986	492.93	11-16	1865	497.52
10%	13-14	7%	9%		6%	8%	
0-9		0-8	2385	476.74	0-10	2689	480.89
10%	0-12	9%	11%		11%	12%	

In order to ensure that the entire range of the Core Content for Assessment is represented by the KCCT, tests are administered using six test forms for Reading, Mathematics, Science and Social Studies and 12 forms for Arts & Humanities and Practical Living. There is minimal overlapping between forms (Hoffman & Bacci, 2002). As each form is potentially measuring students' knowledge of specific aspects of a broad spectrum of content, it is important to look at relationships between KCCT and other achievement measures when the particular test form is taken into consideration. Correlations that are especially high or low would indicate that one form might be measuring student achievement differently than other forms.

Table 25 presents correlations between KCCT and ACT scale scores, separated by year and form number. No correlations stand out among the subject areas, all being within between .02 and .07 of one another. All of the KCCT forms appear to be measuring student achievement in similar ways.

Table 25. KCCT/ACT Correlations by Test Form and Graduation Year

	Class of 2001 Reading	Class of 2002 Reading	Class of 2000 Math	Class of 2001 Math	Class of 2002 Math	Class of 2000 Science	Class of 2001 Science	Class of 2002 Science
1A	.61	.64	.71	.77	.77	.58	.62	.63
2A	.61	.59	.74	.73	.78	.58	.61	.66
3A	.57	.61	.75	.76	.77	.61	.60	.65
4A	.57	.59	.74	.77	.78	.65	.64	.63
5A	.59	.59	.74	.76	.77	.59	.63	.65
6A	.58	.62	.74	.74	.76	.59	.60	.62

Common Factor Analysis

Common factor analysis was conducted as another way of exploring possible differences among the different achievement measures and content areas (Hoffman, 1998). The technique examines the pattern of correlations among a set of variables and attempts to create a smaller set of hypothetical variables that can provide as much of the information about students' performance as the original variables. This small set of hypothetical variables can then be used to describe what the larger set of variables appears to be measuring. These hypothetical variables, called factors, are created as a weighted sum of the original measures.

In the present analysis, principle axis factors were extracted, using varimax orthogonal rotation. The rotation procedure is used following initial extraction in order to maximize high correlations and minimizing lower ones, thus allowing for easier interpretation of factors (Tabachnick and Fidell, 2001).

As shown in Table 26, two factors were detected. Factor "loadings" represent the meaning of the factors. The amount of information captured by the factors is represented by the *percent of total variance explained*. The first factor is the strongest, capturing 41.31% of the information about student achievement that is assessed by all of the measures. All ACT and KCCT measures show high loadings on this factor (noted in bold), meaning that the factor

represents the information in each of these to a fairly high degree. The second factor explains another 19.55% of the information in the set of measures. The second factor captures information about student achievement that is assessed by GPA. No factors seem to capture information that is content-specific. These two factors account for 60.86% of the information possible. The remainder is residual information that is either (a) unique to the separate measures, (b) unique to smaller sets of the measures, or (c) is unreliable information.

Table 26. Common Factor Analysis of Student-Level Assessments – Two Factors

Subjects		Factor Loadings	
		1	2
ACT	English	**0.82**	0.30
	Science Reasoning	**0.79**	0.22
	Reading	**0.79**	0.22
	Math	**0.77**	0.28
KCCT	Math	**0.74**	0.29
	Science	**0.72**	0.25
	Social Studies	**0.70**	0.30
	Reading	**0.63**	0.34
	Practical Living	**0.48**	0.25
	Arts & Humanities	**0.55**	0.26
Grade Point Average	Science	0.26	**0.74**
	English	0.25	**0.78**
	Social Studies	0.23	**0.71**
	Math	0.32	**0.69**
Percent of Total Variance Explained by Factors		41.13	19.55

In an attempt to create factors defined by fewer measures that might match content areas, a four-factor solution was calculated. The result, in Table 27, shows four subsets of measures that define the four factors. The first factor is essentially an ACT factor. The second is a GPA factor. The third factor captures KCCT information, with the exception of Math. The fourth factor appears to be a math factor, with high loadings for both ACT and KCCT math. This solution accounts for more of the total information in the data (slightly over 68%) than the two-factor solution, and shows that there appears to be something specific to math, but not to the other subject areas, that adds to the information on student performance.

Table 27. Principal Factors Analysis of Student-Level Assessments – Four Factors

Subjects		Factor Loadings			
		1	2	3	4
ACT	English	**0.68**	0.28	0.45	0.19
	Science Reasoning	**0.68**	0.22	0.30	0.37
	Reading	**0.75**	0.20	0.42	0.06
	Math	**0.56**	0.26	0.26	**0.61**
KCCT	Math	0.41	0.24	0.41	**0.61**
	Science	0.38	0.19	**0.54**	0.37
	Social Studies	0.31	0.22	**0.72**	0.22
	Reading	0.32	0.28	**0.66**	0.10
	Practical Living	0.23	0.21	**0.51**	0.09
	Arts & Humanities	0.21	0.19	**0.64**	0.14
Grade Point Average	Science	0.17	**0.73**	0.17	0.17
	English	0.18	**0.77**	0.26	0.01
	Social Studies	0.17	**0.69**	0.22	0.04
	Math	0.15	**0.70**	0.14	0.33
Percent of Total Variance Explained by Factors		21.64	17.91	19.43	9.11

Correlations for Number of Courses Taken

Table 28 and Table 29 present correlational results for number of courses. Table 28 shows the intercorrelations for numbers of courses taken. As would be expected from high school graduation requirements, correlations between numbers of courses taken in the different content areas are generally low. All correlations with the number of English courses are low because nearly all students take four years of English. There is a slight trend for students who take more math to also take more science. Table 29 presents correlations between numbers of courses taken and the other indicators of student achievement. As could be anticipated from the box and whiskers plots previously presented in Figures 8 through 10, these correlations are modest with the exception of mathematics courses. Students who take more mathematics courses have a tendency to have higher math KCCT scores, higher ACT math scores, and higher math GPAs. Positive correlations for number of math courses may indicate simply that better students tend to take more math courses.

Table 28. Intercorrelations of Number of Courses

Number of Courses	English	Math	Science	Social Studies
English	1.00			
Math	0.03	1.00		
Science	0.03	0.34	1.00	
Social Studies	0.02	0.18	0.19	1.00

Table 29. Correlations Between Number of Courses Taken and Other Assessments

Variables		Number of Courses			
		English	Math	Science	Social Studies
KCCT	1. Reading	.01	.37	.16	.10
	2. Math	.02	.48	.21	.06
	3. Science	.02	.38	.19	.09
	4. Social Studies	.01	.37	.17	.13
	5. Arts & Humanities	.01	.31	.14	.11
	6. Practical Living	.01	.29	.12	.08
ACT	7. English	.01	.43	.16	.08
	8. Reading	.01	.35	.15	.09
	9. Math	.01	.54	.22	.04
	10. Science Reasoning	.01	.43	.19	.05
	11.Composite	.01	.49	.20	.07
GPA	12. English	.01	.38	.15	.08
	13. Math	.01	.43	.15	.03
	14. Science	.01	.38	.10	.05
	15. Social Studies	.01	.36	.15	.09

Student Motivation

Critics of school-level assessments like the KCCT have argued that students are often not motivated to do well on them because they have little direct impact on the student's academic achievement (Hoffman, 1998). If this were the case, many unmotivated students would be expected to perform at a lower level on the KCCT than on the ACT, a test that directly impacts a student's educational prospects.

As previously mentioned, the KCCT includes a short student survey that is administered at the end of each subject test. For example, following the mathematics portion of the KCCT, students are asked *How hard did you try on this math test?* and *How well did you do on this math test?* For purposes of exploring student motivation, analysis was conducted using the variable that measured how hard a student reported trying on the test.

The line of reasoning is that a motivated student will tend to try harder on a test than will an unmotivated student. In the same manner, a student who tries harder would be expected to perform better. As a result, a student's level of effort would exhibit a positive relationship with test scores.

Figure 14, Figure 15, Figure 16, and Figure 17 depict the relationships between level of student-reported effort and scores on KCCT Reading, Math, Science and Social Studies tests respectively. Note that the different answer categories for the effort variable reflect the formatting changes that were made to the questionnaires from year to year. Reading is the only content area that exhibits a steady increase in scale score as level of effort increases. Correlation data does not necessarily imply a causal connection, and in the case of subjects other than reading, the data point to an alternate conclusion. In the areas of math and social studies, it

appears that there is a slight peak in test scores at the bottom of the effort scale. This suggests that, rather than a measure of student motivation, this variable is more accurately a measure of students' perceptions of the test's level of difficulty. As the survey was administered following the test, students were not indicating whether they intended to try, but rather if they tried hard while taking the test. Students who indicated that they did not try, but who performed well on the test, were not necessarily unmotivated, but may have found that the test was not particularly challenging.

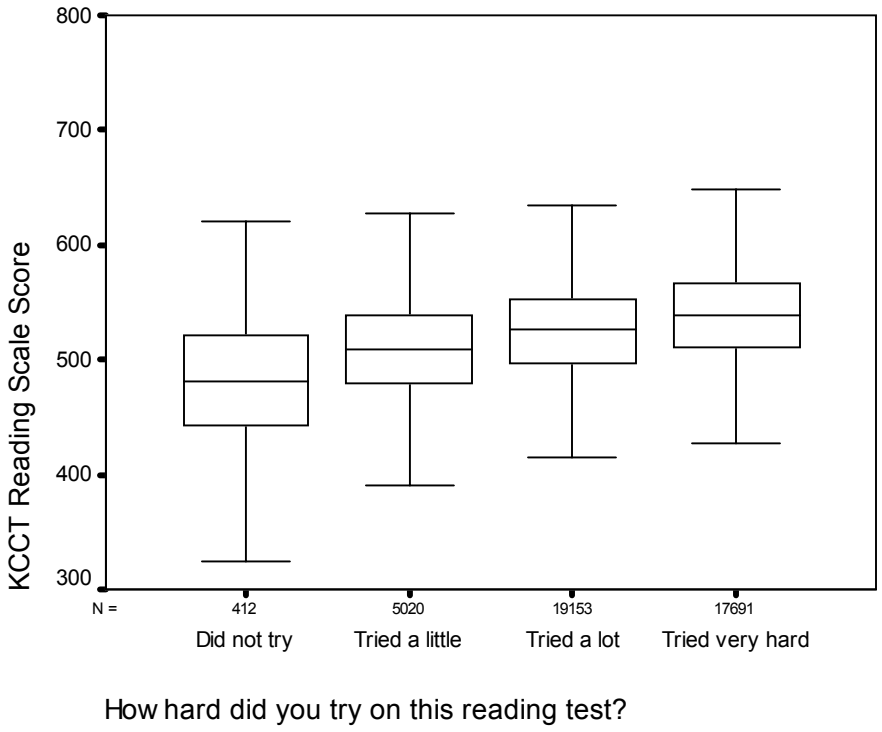


Figure 14. Relationship between student effort and KCCT Reading scale score.

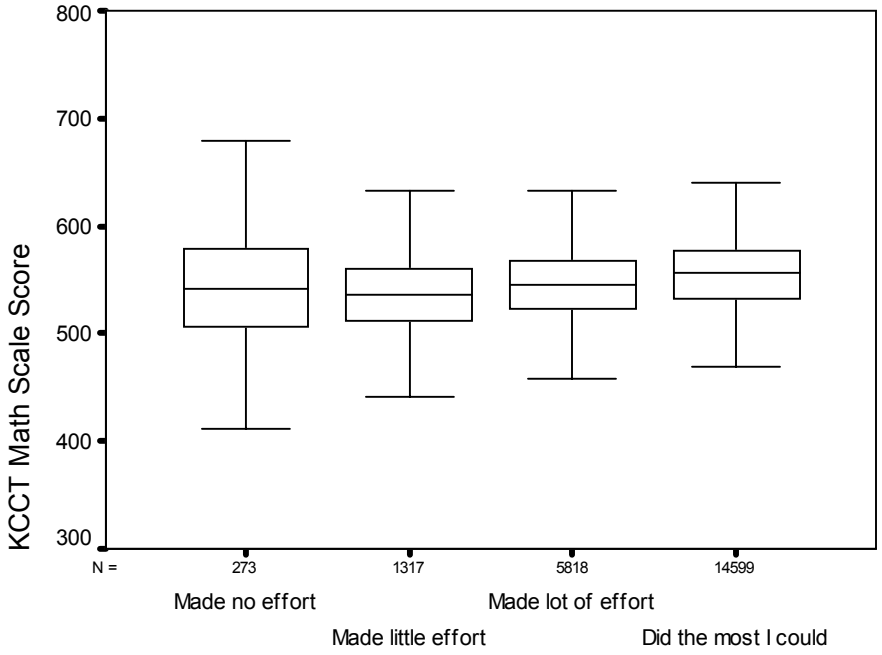


Figure 15. Relationship between student effort and KCCT Math scale score.

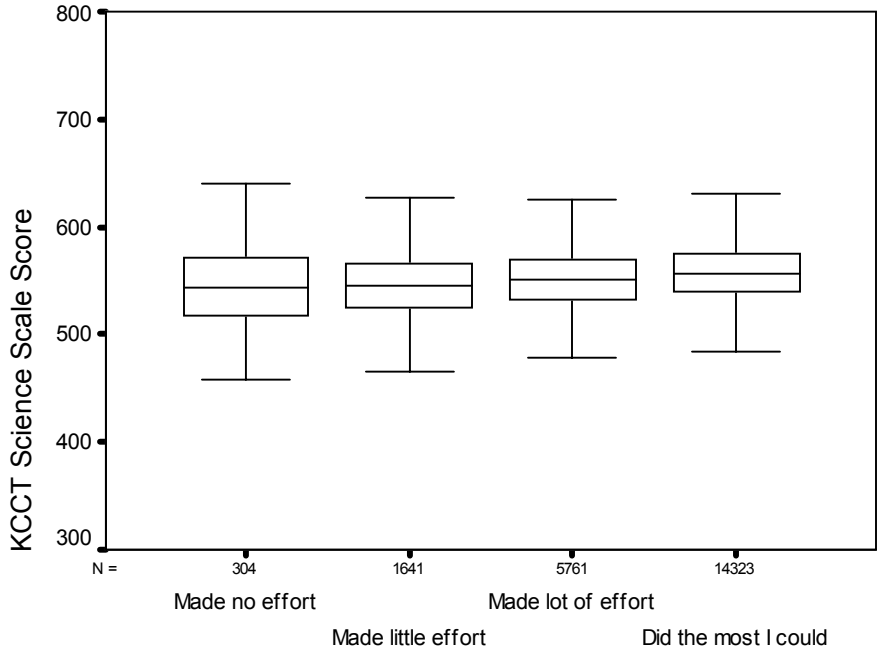


Figure 16. Relationship between student effort and KCCT Science scale score.

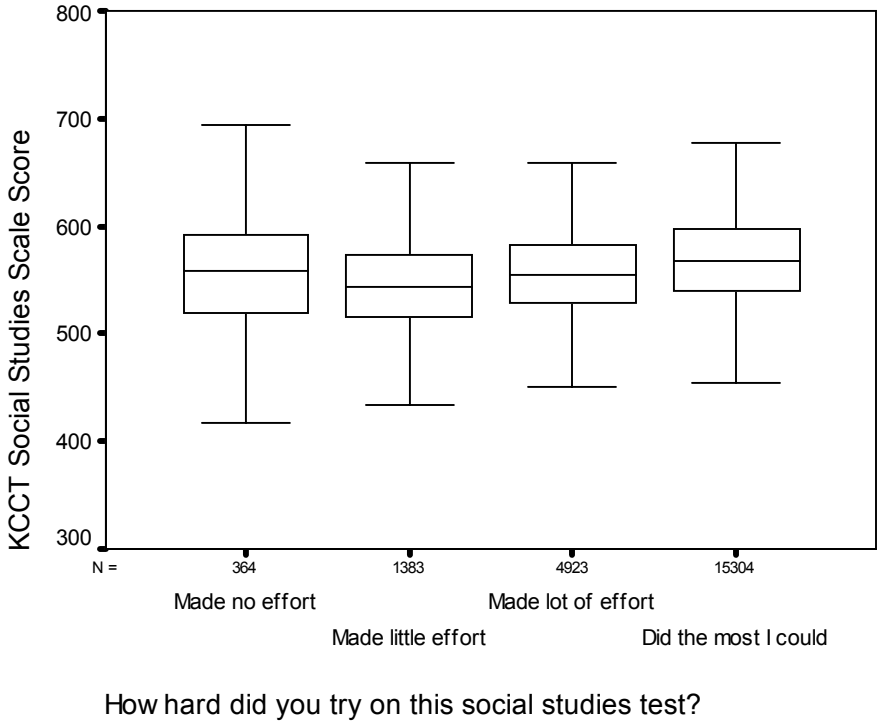


Figure 17. Relationship between student effort and KCCT Social Studies scale score.

To test this notion, crosstabulations (see Table 30) were conducted in each subject, comparing the effort variable with another variable that asked students how well they thought they had done on the test. In Table 30, column percentages can be added to get a total of 100% of students who answered within each effort category for each subject-specific questionnaire. If the effort variable was in fact a measure of students' perceptions of test difficulty, then it would be expected that students who indicated that they *did not try* might also report that they thought they *did well* on the test. For KCCT Social Studies, this was the case. About 74% of students who reported that they did not try on the social studies assessment also stated that they did *very well* or *well*. On math and science assessments, roughly half (54.5% and 49.8%, respectively) of students who reported not trying also stated that they did *very well* or *well*. As suggested in Table 30, most students (64.2%) who *did not try* on the KCCT Reading test also believed that they *did poorly* or *did very poorly*.

One possible reason for the difference in patterns among reading and the other subject areas is that students take the former during the 10th grade. Perhaps students were more familiar with the test format in the 11th grade, and thus did not feel as if they had to try hard in order to do well. However, further exploration is necessary to understand such differences between grade levels, as well as understanding student motivation and its impacts on KCCT performance.

Table 30. Crosstabulation of Student Motivation and Perceived Performance

How well did you do?		How hard did you try? Did not try	Tried a little	Tried a lot	Tried very hard
Reading	Did very poorly	38.1%	4.5%	1.1%	.9%
	Did poorly	26.1%	27.8%	14.7%	6.8%
	Did well	24.1%	62.6%	79.2%	78.8%
	Did very well	11.7%	5.0%	5.0%	13.5%
Math	Did very poorly	26.7%	15.6%	6.2%	4.6%
	Did poorly	18.8%	40.9%	33.5%	22.7%
	Did well	27.8%	35.7%	55.5%	60.6%
	Did very well	26.7%	7.7%	4.7%	12.1%
Science	Did very poorly	26.9%	13.2%	5.8%	5.0%
	Did poorly	23.3%	48.0%	37.7%	27.3%
	Did well	34.2%	35.2%	54.3%	60.5%
	Did very well	15.6%	3.6%	2.2%	7.2%
Social Studies	Did very poorly	9.8%	4.9%	1.7%	1.4%
	Did poorly	16.2%	35.8%	17.8%	9.0%
	Did well	34.9%	52.8%	73.3%	66.0%
	Did very well	39.1%	6.6%	7.2%	23.6%

Regression Approach in Search of Method Effects

One other alternative analysis was conducted to identify method effects in students' ACT and KCCT scores. Regression analysis looks at how variables in combination with each other can be used to predict scores on a dependent variable. For example, results from the previous sections suggest that both testing year and ACT score are related to KCCT scores. If we were to look at student scores across all three years of data used in this study, year of testing and ACT score, in combination, would be expected to predict KCCT scores better than either by itself.

In the present analysis, the particular combination in which we are most interested is the combination of ACT score and some measure of the analytical skills that are hypothesized to distinguish KCCT assessments from ACT assessments. As a proxy for such a measure, we chose KCCT Reading scores. The KCCT Reading assessment contains an open response component that requires students to read a brief passage and then compose an organized analytical response. Previously presented correlations show that KCCT Reading is reasonably highly correlated with KCCT Math and KCCT Science.

If it were the case that KCCT assessments were tapping into some analytical skills that were not measured by the ACT, then KCCT Math, for example, could be better predicted by a combination of ACT Math and KCCT Reading than by ACT Math alone.

For our analysis, we summarized across all three years by combining year, KCCT Math, and KCCT Reading as predictors of ACT Math scores using students from all three years of data.

Table 31 presents results for math and for science. The rows in the table can be read as equations predicting the dependent variable from the other variables. For example, the standardized coefficient for year in the first row (.00) indicates that testing year has no ability to predict ACT Math scores. The R-squared is an indication of the strength of the prediction. Testing year alone explains none of the variation in ACT Math.

Table 31. Method Regressions

Dependent Variable	Predictor Variables with Standardized Coefficients			R^2
	Graduation Year	Content	Method/Skill	
ACT Math	Year (.00)			.00
ACT Math	Year (-.03)	KCCT Math (.75)		.56
ACT Math	Year (-.03)	KCCT Math (.68)	KCCT Reading (.14)	.60
ACT Math	Year (-.02)	KCCT Math (.58)	ACT Reading (.30)	.62
KCCT Math	Year (.04)			.00
KCCT Math	Year (.04)	ACT Math (.76)		.58
KCCT Math	Year (.02)	ACT Math (.64)	KCCT Reading (.23)	.62
KCCT Math	Year (.02)	ACT Math (.61)	ACT Reading (.07)	.62
ACT Science	Year (-.01)			.00
ACT Science	Year (-.02)	KCCT Science (.62)		.39
ACT Science	Year (-.03)	KCCT Science (.47)	KCCT Reading (.27)	.44
ACT Science	Year (-.02)	KCCT Science (.28)	ACT Reading (.50)	.57
KCCT Science	Year (.01)			.00
KCCT Science	Year (.02)	ACT Science (.62)		.39
KCCT Science	Year (-.01)	ACT Science (.45)	KCCT Reading (.35)	.46
KCCT Science	Year (.00)	ACT Science (.35)	ACT Reading (.19)	.48

The small negative coefficient for year indicates that when KCCT is added to the equation, the relationship between testing year and ACT Math becomes negative. As the value of year increases, we can expect the value of ACT score to decrease slightly. As seen before, ACT scores decreased slightly over the three years. Note that the R-squared of .56 indicates that slightly over half (56%) of the variation in students' ACT scores can be predicted by the combination of testing year and KCCT score.

The third row suggests that adding KCCT Reading to the model allows us to explain more of the variation in ACT Math. The .04 change in R-squared from the second row to the third row indicates that KCCT Reading is adding something to the prediction of ACT Math.

Similarly, the fourth row of Table 31 shows what happens when ACT Reading, as a substitute index for ACT test-taking skills, is added to KCCT Math and testing year. Note that the predictive power increases to 62% and ACT Reading receives a weight of .30. There appears to be some component of performance captured by ACT Reading that adds to the prediction of ACT Math.

The second set of equations in Table 31 shows the reverse analysis with KCCT Math as the variable being predicted. Adding KCCT Reading to the equation increases the predictive

power by .04. KCCT Math can be better predicted from a combination of ACT Math and KCCT Reading than by ACT Math alone. Substituting ACT Reading for KCCT Reading does not change the predictive power of the equation. It appears that ACT Reading can be used as successfully as KCCT Reading in predicting KCCT Math scores.

The final two sections of the table show the parallel analyses for science. The conclusions are similar. In all four sets of equations, scores are best predicted by a combination of year, subject-specific measurement, and ACT Reading. It appears that performance on the open-response reading portion of the KCCT is not providing any additional information with which to better predict KCCT Math and Science scores. In fact, there appears to be some method-related component at work when predicting ACT scores that does not enter into the prediction of KCCT scores.

The unidimensionality of test scores have recently been questioned (Sicoly, 2002). Hirsch & Miller (1991) reported on a dominant factor across ACT Reading, Science Reasoning, and English. Only ACT Math was interpretable in terms of content. A common aspect of ACT Science Reasoning and ACT Reading is that items on both tests are passage dependent; that is students read a passage and then answer questions related to it. KCCT Science is not passage dependent, but many of the items do require students to read a short paragraph or interpret a figure or graph in order to respond. Mathematics ability is often considered a prerequisite for success in science (Detloff, 1982). An important question for both ACT and KCCT is, "Does math ability add to science predictions after reading is taken into account?"

Multiple regression analysis was conducted using science, reading and math scores to predict both ACT and KCCT Science scores. If math skills were indeed a component of success in science, then adding math to the regression equation would increase the predictability of science scores. Table 32 depicts results of the analysis. Math skills do add to the predictability of science scores for both ACT and KCCT. For predicting KCCT Science, the best combination of scores is ACT Science, KCCT Reading and KCCT Math. ACT Science is best predicted by a combination of KCCT Science, ACT Reading and ACT Math. In both cases, content knowledge and test-specific skills seem to be the best predictors of achievement in science on either test. ACT Reading adds significantly to the prediction of ACT Science. This is consistent with Hirsch and Miller's (1991) conclusion that skills in reading are highly related to achievement on the science portion of ACT. Reading adds predictability to KCCT Science also, but to a much lesser degree.

Table 32. Math and Reading as Predictors of Science Scores

Dependent Variable	Predictor Variables with Standardized Coefficients			R^2
KCCT Science	ACT Science (.62)			.39
KCCT Science	ACT Science (.45)	KCCT Reading (.33)		.46
KCCT Science	ACT Science(.25)	KCCT Reading (.21)	KCCT Math (.39)	.54
KCCT Science	ACT Science (.62)			.39
KCCT Science	ACT Science (.45)	KCCT Reading (.33)		.46
KCCT Science	ACT Science(.27)	KCCT Reading (.28)	ACT Math (.27)	.49
KCCT Science	ACT Science (.61)			.37
KCCT Science	ACT Science (.40)	ACT Reading (.30)		.41
KCCT Science	ACT Science(.18)	ACT Reading (.21)	KCCT Math (.43)	.52
KCCT Science	ACT Science (.61)			.37
KCCT Science	ACT Science (.40)	ACT Reading (.30)		.41
KCCT Science	ACT Science(.23)	ACT Reading (.24)	ACT Math (.28)	.45
ACT Science	KCCT Science (.61)			.37
ACT Science	KCCT Science (.29)	ACT Reading (.55)		.57
ACT Science	KCCT Science (.14)	ACT Reading (.37)	ACT Math (.42)	.66
ACT Science	KCCT Science (.61)			.37
ACT Science	KCCT Science (.29)	ACT Reading (.55)		.57
ACT Science	KCCT Science (.15)	ACT Reading (.47)	KCCT Math (.29)	.61
ACT Science	KCCT Science (.62)			.39
ACT Science	KCCT Science (.47)	KCCT Reading (.27)		.44
ACT Science	KCCT Science (.21)	KCCT Reading (.13)	ACT Math (.55)	.61
ACT Science	KCCT Science (.62)			.39
ACT Science	KCCT Science (.47)	KCCT Reading (.27)		.44
ACT Science	KCCT Science (.26)	KCCT Reading (.16)	KCCT Math (.40)	.52

Gender, Racial and Socioeconomic Differences

Analyses were conducted to compare performance on KCCT and other achievement measures among students from varying backgrounds. Males and females, racial groups, and groups similar in socioeconomic status tend to differ in their average test performance on a variety of tests. The important question for judging bias in Kentucky's KCCT scores is whether any differences between the sexes, racial, or socioeconomic groups are larger than those observed on the other measures of student achievement.

Tables 33, Table 34 and Table 35 show performance means for males and females for KCCT, ACT, and GPA respectively. Keeping in mind that only students who opted to take the ACT and were able to be matched with their KCCT data are included here, it is interesting to note the difference in sample size of males and females. The sample size alone suggests that female students may be more motivated to pursue a postsecondary education. For both the KCCT scores (Table 33) and the ACT scores (Table 34), females have higher scores, on average, on the verbally oriented subjects (English, Reading, Social Studies, Arts & Humanities and

Practical Living), while males have higher scores in Math and Science. In Table 35, females appear to have higher grade-point averages than males across all subject areas. Effect sizes can be interpreted as Z-scores on a standard normal distribution, and can be used to estimate the percentage of a control group that would be above or below the average score in an experimental group (Coe, 2002). For example, the effect size of -.35 for KCCT Reading indicates that approximately 64% of females could be expected to score above the average male student on KCCT reading. Effect sizes are generally negative, with the exception of both KCCT and ACT Math and Science. In terms of ACT Math, roughly 60% of females would be expected to score below the average male on ACT Math. Cole and Willingham (1997) suggest that, as a rule, females tend to avoid taking mathematics and science classes. They found a similar pattern examining both national level ACT scores and SAT scores.

Table 33. KCCT Descriptive Statistics by Gender Across Graduation Years 2000-2002

KCCT Component	Gender	Mean Scale Score	Standard Deviation	Number of Cases	Effect Size
Reading*	Male	519.31	45.98	18,478	-.35
	Female	535.36	43.87	24,806	
Math	Male	550.53	42.23	28,184	.15
	Female	544.63	38.50	37,938	
Science	Male	556.72	33.53	28,184	.20
	Female	550.30	30.39	37,938	
Social Studies	Male	561.79	46.31	28,314	-.06
	Female	564.33	44.26	37,938	
Arts & Humanities	Male	521.89	58.15	28,184	-.28
	Female	538.51	58.18	37,938	
Practical Living*	Male	521.02	56.10	18,478	-.24
	Female	534.78	58.20	24,806	

*KCCT was changed in 1999. Tests given prior to 1999 were not used for this analysis. KCCT Reading and Practical Living scores not available for the class of 2000

Table 34. ACT Descriptive Statistics by Gender Across Graduation Years 2000-2002

ACT Component	Gender	Mean Scale Score	Standard Deviation	Number of Cases	Effect Size
English	Male	19.11	5.72	28,803	-.14
	Female	19.93	5.58	38,562	
Reading	Male	20.45	6.01	28,802	-.04
	Female	20.67	5.74	38,561	
Math	Male	20.02	4.94	28,802	.27
	Female	18.79	4.28	38,562	
Science Reasoning	Male	20.80	4.65	28,802	.23
	Female	19.78	4.05	38,560	
Composite	Male	20.22	4.78	28,802	.07
	Female	19.92	4.38	38,560	

Table 35. GPA Descriptive Statistics by Gender Across Graduation Years 2000-2002

Subject	Gender	Mean Self-Reported Grade	Standard Deviation	Number of Cases	Effect Size
English	Male	3.04	0.73	22,723	-.40
	Female	3.32	0.65	31,666	
Math	Male	3.10	0.78	20,371	-.12
	Female	3.19	0.73	28,890	
Social Studies	Male	3.27	0.73	21,054	-.16
	Female	3.38	0.68	29,216	
Science	Male	3.09	0.78	19,471	-.20
	Female	3.24	0.72	28,076	

Regression analysis was used to examine the extent to which KCCT differences in performance for males and females are similar to differences in ACT scores. For each of four content areas, a regression equation was calculated predicting KCCT scores from year and the matching ACT content score. For KCCT social studies, the ACT composite score was used. Then, a second equation was created which added gender. If KCCT scores are exhibiting greater gender differences than ACT scores, gender will have a significant weight and there will be a meaningful increase in the prediction of KCCT scores. The resulting pairs of equations are presented in Table 36 along with the R-squares and changes in R-squares. With the possible exception of reading, the regression weights for gender are negligible and the changes in R-squares are non-existent. For reading, gender has a noticeable weight (.16) and the prediction of KCCT reading is increased slightly (2%). Gender is coded such that the positive weight means that females tend to have higher reading scores than would be expected from gender differences in ACT reading. This analysis does not necessarily mean that males are unfairly discriminated against by the KCCT assessment. It does mean that compared to their female counterparts, they do not do as well on KCCT reading as might be predicted from their ACT scores. The effect is small, however. There are well established gender differences favoring females in writing skills (Cole and Willingham, 1997), and the KCCT is a much more writing-oriented test than ACT. This might account for some of the observed differences.

Table 36. Regressions Results Showing Adjusted Strengths of Gender Effects

KCCT Test	Standardized Coefficient			R^2	Change in R^2 due to Gender
	Graduation Year	ACT Control	Gender		
Reading	.06	.59		.36	
Reading	.06	.59	.16	.38	.02
Math	.05	.75		.56	
Math	.05	75	.03	.56	.00
Science	.04	.61		.37	
Science	.04	.61	-.03	.37	.00
Social Studies	.04	.67		.44	
Social Studies	.04	.67	.05	.45	.01

Note: Gender is coded such that positive coefficients indicate females have higher scores than males.

Tables 37 through 39 present performance statistics by race. Differences in performance means are most obvious for African-American students who, on average, have the lowest KCCT scores, lowest ACT scores, and lowest GPAs. Asian students tend to have the highest scores with Hispanic students and students who identify themselves as part of the "Other" racial category showing means that are slightly below the means for white students. Effect scores mirror these differences. African American students' effect scores are highest in magnitude and are negative in direction. In KCCT Math, for example, it would be expected that approximately 78% of white students would score above the average African American student.

Table 37. KCCT Descriptive Statistics by Ethnic Group Across Graduation Years 2000-2002

KCCT Component		White	African-American	Hispanic	Asian	Other
Reading*	Mean	530.35	505.42	523.84	538.89	527.20
	S.D.	44.74	45.18	45.65	55.79	49.23
	N	38,988	3196	226	359	538
	Effect Size		-0.55	-0.14	0.19	-0.07
Math	Mean	549.42	517.87	541.10	566.50	545.64
	S.D.	38.41	46.98	47.40	45.63	46.95
	N	59,505	4844	339	565	855
	Effect Size		-0.78	-0.21	0.42	-0.09
Science	Mean	554.86	530.31	547.49	560.62	552.03
	S.D.	30.72	34.61	35.63	41.84	38.76
	N	59,505	4844	339	565	855
	Effect Size		-0.77	-0.23	0.18	-0.09
Social Studies	Mean	565.09	539.72	558.45	574.00	563.97
	S.D.	44.25	46.49	46.65	55.20	51.91
	N	59,505	4844	339	565	855
	Effect Size		-0.56	-0.15	0.20	-0.02
Arts & Humanities	Mean	533.36	507.60	522.90	539.40	531.30
	S.D.	58.43	55.09	59.60	69.72	63.63
	N	59,505	4844	339	565	855
	Effect Size		-0.44	-0.18	0.10	-0.04
Practical Living*	Mean	530.83	505.00	520.07	541.07	527.29
	S.D.	57.16	54.71	55.90	78.74	62.25
	N	38,988	3196	226	359	538
			-0.45	-0.19	0.18	-0.06

*KCCT was changed in 1999. Tests given prior to 1999 were not used for this analysis. KCCT Reading and Practical Living scores not available for the class of 2000

Table 38. ACT Descriptive Statistics by Ethnic Group Across Graduation Years 2000-2002

ACT		White	African-American	Hispanic	Asian	Other
English	Mean	19.85	16.04	18.59	21.04	19.85
	S.D.	5.59	4.90	5.98	6.86	6.16
	N	60,614	4940	345	574	871
	Effect Size		-0.68	-0.22	0.21	0.00
Reading	Mean	20.87	16.88	19.71	21.34	20.93
	S.D.	5.81	4.82	6.38	6.93	6.34
	N	60,612	4940	345	574	871
	Effect Size		-0.68	-0.20	0.08	0.01
Math	Mean	19.50	16.64	19.16	22.67	19.87
	S.D.	4.60	3.33	4.89	6.06	5.09
	N	60,613	4940	345	574	871
	Effect Size		-0.62	-0.07	0.69	0.08
Science Reasoning	Mean	20.44	17.30	19.50	21.59	20.46
	S.D.	4.29	3.62	4.58	5.34	4.74
	N	60,611	4940	345	574	871
	Effect Size		-0.72	-0.22	0.26	0.00
Composite	Mean	20.29	16.85	19.40	21.80	20.41
	S.D.	4.50	3.61	4.90	5.80	5.06
	N	60,611	4940	345	574	871
	Effect Size		-0.75	-0.20	0.33	0.03

Table 39. GPA Descriptive Statistics by Ethnic Group Across Graduation Years 2000-2002

Subject		White	African-American	Hispanic	Asian	Other
English	Mean	3.23	2.85	3.02	3.39	3.18
	S.D.	0.69	0.72	0.76	0.65	0.70
	N	48,897	4022	279	464	685
	Effect Size		-0.65	-0.30	0.23	-0.07
Math	Mean	3.18	2.73	3.11	3.46	3.17
	S.D.	0.74	0.77	0.75	0.70	0.77
	N	44,670	3274	239	439	621
	Effect Size		-0.60	-0.09	0.37	-0.01
Science	Mean	3.21	2.78	3.06	3.43	3.17
	S.D.	0.74	0.79	0.76	0.67	0.76
	N	42,652	3555	239	464	610
	Effect Size		-0.57	-0.20	0.29	-0.05
Social Studies	Mean	3.37	3.00	3.21	3.46	3.31
	S.D.	0.69	0.76	0.73	0.69	0.69
	N	45,183	3751	247	424	624
	Effect Size		-0.52	-0.23	0.13	-0.09

Again, the more important validity question is whether KCCT scores have racial differences that are unusually high compared to ACT. Table 40 presents results which use ACT as a basis for judging KCCT racial differences. Because race can only be treated as a categorical variable, simple regression weights, like those presented in Table 31, are not presented. Only the differences in the predictability of KCCT from ACT and year, with and without including race, are presented. The changes in predictability, i.e., the changes in R-squares, are negligible in all cases. The differences among the racial groups observed in Tables 37 through 39 do not appear to be a function of bias in KCCT testing. Though conclusions cannot be drawn from these data about the existence of bias in any of the measures, it can be said that KCCT appears not to be any more or less biased than other measures of student achievement.

Table 40. Regressions Results Showing Adjusted Strengths of Race Effects

KCCT Test	Predictors included	R^2	Change in R^2 due to Race
Reading	Year & ACT reading	0.36	
Reading	Year, ACT reading, & race	0.36	0.00
Math	Year & ACT math	0.56	
Math	Year, ACT math & race	0.57	0.01
Science	Year & ACT science	0.37	
Science	Year, ACT science, & race	0.38	0.01
Social Studies	Year & ACT composite	0.44	
Social Studies	Year, ACT composite, & race	0.44	0.00

Table 41, Table 42, and Table 43 show performance means for students grouped by socioeconomic status (SES). In this case, SES is measured using parents' combined level of income, as estimated by students on the ACT questionnaire. The ACT questionnaire measures income at the ordinal level, presenting nine categories from which students are to choose. For ease of presentation, and in an attempt to mirror familiar class groupings (poor, working, middle and upper), the variable was recoded into four categories. Income categories were determined in relation to the current poverty threshold, which is approximately $18,000 in annual income for a family of four. As indicated by the data, as SES (as indicated by level of income) increases, mean scores in all of the achievement measures increase as well. Again, effect scores reflect this pattern. In terms of KCCT math specifically, approximately 78% of students whose parents' income is less than $18,000.00 annually would be expected to score below the average student in this highest income grouping.

Table 41. KCCT Descriptive Statistics by Parents' Income (SES Indicator) for Graduating Classes 2000-2002

Measure		Less than $18K	$18K to $30K	$30K to $60K	More than $60K
Reading*	Mean	513.89	519.41	528.77	539.89
	S.D.	43.98	43.46	43.95	45.93
	N	4574	6945	15,800	10,950
	Effect Size		0.12	0.33	0.57
Math	Mean	529.48	537.60	547.92	560.06
	S.D.	42.64	38.67	37.95	37.85
	N	7013	10,700	24,483	16,340
			0.20	0.46	0.76
Science	Mean	541.11	546.71	553.99	561.33
	S.D.	33.49	31.07	30.10	31.13
	N	7013	10,700	24,483	16,340
			0.18	0.40	0.63
Social Studies	Mean	546.71	554.03	564.06	576.02
	S.D.	44.07	42.48	42.86	45.90
	N	7013	10,700	24,483	16,340
			0.16	0.38	0.65
Arts & Humanities	Mean	514.03	521.66	531.82	545.09
	S.D.	54.78	53.51	56.27	63.16
	N	7013	10,700	24,483	16,340
			0.13	0.30	0.53
Practical Living*	Mean	513.58	519.63	529.60	540.16
	S.D.	54.85	53.02	56.49	60.44
	N	4574	6945	15,800	10,950
			0.10	0.28	0.46

*KCCT was changed in 1999. Tests given prior to 1999 were not used for this analysis. KCCT Reading and Practical Living scores not available for the class of 2000

Table 42. ACT Descriptive by Parents' Income (SES Indicator) for Graduating Classes 2000-2002

Measure		Less than $18K	$18K to $30K	$30K to $60K	More than $60K
English	Mean	17.21	18.16	19.67	21.46
	S.D.	5.22	5.23	5.50	5.64
	N	7195	10,931	24,888	16,604
	Effect Size		0.17	0.44	0.75
Reading	Mean	18.60	19.46	20.64	22.14
	S.D.	5.39	5.51	5.77	5.94
	N	7194	10,931	24,887	16,604
	Effect Size		0.15	0.35	0.60
Math	Mean	17.32	18.02	19.31	21.08
	S.D.	3.62	3.89	4.44	5.00
	N	7195	10,931	24,887	16,604
	Effect Size		0.15	0.43	0.81
Science Reasoning	Mean	18.56	19.23	20.29	21.54
	S.D.	3.93	3.99	4.22	4.46
	N	7194	10,930	24,887	16,604
	Effect Size		0.15	0.40	0.69
Composite	Mean	18.05	18.85	20.10	21.69
	S.D.	3.97	4.08	4.41	4.69
	N	7194	10,930	24,887	16,604
	Effect Size		0.18	0.45	0.80

Table 43. GPA Descriptive Statistics by Parents' Income (SES Indicator) for Graduating Classes 2000-2002

Measure		Less than $18K	$18K to $30K	$30K to $60K	More than $60K
English	Mean	3.03	3.11	3.22	3.32
	S.D.	0.73	0.71	0.69	0.66
	N	5831	9050	20,534	13,653
	Effect Size		0.11	0.27	0.42
Math	Mean	2.98	3.04	3.16	3.26
	S.D.	0.80	0.77	0.74	0.71
	N	4707	7767	18,744	13,225
	Effect Size		0.08	0.24	0.37
Social Studies	Mean	3.15	3.25	3.35	3.46
	S.D.	0.77	0.73	0.69	0.64
	N	5285	8277	18,948	12,840
	Effect Size		0.14	0.28	0.44
Science	Mean	3.00	3.07	3.18	3.29
	S.D.	0.80	0.77	0.74	0.70
	N	4561	7426	18,016	12,847
	Effect Size		0.09	0.24	0.39

Table 44 presents regression analysis results when SES is entered as a predictor of KCCT scores. The R-squares changes indicate SES is doing little to add to the predictability of KCCT scores. In terms of SES, KCCT is no more biased than other measures of student achievement.

Table 44. Regression Analysis Results Showing Adjusted Strengths of Socioeconomic Effects

KCCT Test	Predictors included	R^2	Change in R^2 due to SES
Reading	Year & ACT reading	0.35	
Reading	Year, ACT reading, & SES	0.36	0.01
Math	Year & ACT math	0.56	
Math	Year, ACT math & SES	0.56	0.00
Science	Year & ACT science	0.37	
Science	Year, ACT science, & SES	0.38	0.01
Social Studies	Year & ACT composite	0.44	
Social Studies	Year, ACT composite, & SES	0.44	0.00

School-Level Scores

Tables 45 through 47 present school-level descriptive statistics for each of the three years based on only those students who took the ACT. Similar to the student-level means, school-level KCCT scores generally increased between the 2000 and 2002 graduation years. Other achievement measures did not represent this upward trend. With the exception of ACT Math, which experienced a slight increase in 2001 before dropping in 2002, all ACT means decreased over the three-year period. Students' GPA essentially did not change during this period.

Table 45. KCCT School-Level Descriptive Statistics for Graduation Years 2000-2002

Subject	Measure	Class of 2000*	Class of 2001	Class of 2002
Reading	Mean	NA	520.45	525.79
	S.D.	NA	19.44	18.51
	N	0	243	249
Math	Mean	538.39	540.88	543.84
	S.D.	21.16	20.93	16.99
	N	245	244	251
Science	Mean	547.61	550.16	550.10
	S.D.	15.51	14.43	13.33
	N	245	244	251
Social Studies	Mean	556.34	558.25	558.59
	S.D.	18.54	19.02	18.81
	N	245	244	251
Arts & Humanities	Mean	518.47	524.87	533.35
	S.D.	23.12	22.89	22.29
	N	245	244	251
Practical Living	Mean	NA	523.33	524.21
	S.D.	NA	18.27	18.98
	N	0	243	249

*KCCT was changed in 1999. Therefore, tests given prior to 1999 were not used.

Table 46. ACT School-Level Descriptive Statistics for Graduation Years 2000-2002

Subject	Measure	Class of 2000	Class of 2001	Class of 2002
English	Mean	19.10	18.83	18.66
	S.D.	1.89	1.99	2.07
	N	245	244	251
Reading	Mean	20.11	19.98	19.97
	S.D.	1.78	1.62	1.94
	N	245	244	251
Math	Mean	18.62	18.69	18.60
	S.D.	1.63	1.63	1.65
	N	245	244	251
Science Reasoning	Mean	19.75	19.71	19.61
	S.D.	1.56	1.44	1.40
	N	245	244	251
Composite	Mean	19.52	19.43	19.33
	S.D.	1.63	1.60	1.62
	N	245	244	251

Table 47. GPA School-Level Descriptive Statistics for Graduation Years 2000-2002

Subject	Measure	Class of 2000	Class of 2001	Class of 2002
English	Mean	3.18	3.18	3.18
	S.D.	0.25	0.27	0.26
	N	243	244	249
Math	Mean	3.11	3.13	3.11
	S.D.	0.27	0.23	0.29
	N	241	242	249
Science	Mean	3.17	3.18	3.16
	S.D.	0.29	0.27	0.31
	N	241	241	248
Social Studies	Mean	3.30	3.32	3.31
	S.D.	0.28	0.25	0.30
	N	244	243	251

Average Within-Year School-Level Correlations

Table 48 presents correlations among these school-level scores. These correlations are average correlations across the three years.[1]

There is a common statistical tendency for correlations to exhibit a slight increase when they are recomputed on data averaged to a higher level of aggregation (Hoffman, 1998). This tendency should result in most of the correlations among school scores in Table 48 being higher than the correlations among student-level scores in Table 15. This is generally the case, except for those correlations involving GPA, and especially the correlations between GPA and both KCCT and ACT, which are noticeably lower at the school level.

The lower school-level correlations for GPA suggests that grading scales are not equivalent across schools. As might be expected, different schools tend to grade differently. As a result, at the school level of analysis there is a weaker relationship between GPA and either KCCT scores or ACT scores. When students' scores are averaged at the school level, observed differences are related not only to differing levels of student achievement, but to the particular school's grading practices resulting in the lower correlations between GPA and both ACT and KCCT.

Again, Hoffman's (1998) data comparing KIRIS to ACT is presented for comparison (Table 49). In this case, the data are not nearly as similar for correlations at the school level for GPA in comparison to both KCCT and ACT. Hoffman showed almost no relationship between school-level GPA and either KIRIS or ACT.[2] While the data presented in Table 48 does not

[1] Average correlations were technically corrected with Fisher's *r* to *z* transformation.

[2] Hoffman's GPA data was calculated differently than GPA for this report; however, when Hoffman's methodology was duplicated, the results were essentially unchanged.

represent a strong relationship, it is much stronger than the relationship found by Hoffman. This data may be an indication that school-level grading practices are becoming more standardized than they were in 1998.

Table 48. Average Within-Year School-Level Correlations for Graduation Years 2000-2002

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
KCCT															
1. Reading*	*1.00*														
2. Math	*0.72*	*1.00*													
3. Science	*0.74*	*0.80*	*1.00*												
4. Social Studies	*0.74*	*0.74*	*0.84*	*1.00*											
5. Arts & Humanities	*0.71*	*0.72*	*0.77*	*0.87*	*1.00*										
6. Practical Living*	*0.81*	*0.71*	*0.67*	*0.72*	*0.71*	*1.00*									
ACT															
7. English	**0.71**	**0.70**	**0.69**	**0.68**	**0.68**	**0.73**	*1.00*								
8. Reading	**0.61**	**0.60**	**0.65**	**0.64**	**0.58**	**0.63**	*0.88*	*1.00*							
9. Math	**0.62**	**0.74**	**0.64**	**0.63**	**0.59**	**0.62**	*0.83*	*0.78*	*1.00*						
10.ScienceReasoning	**0.65**	**0.72**	**0.72**	**0.67**	**0.64**	**0.66**	*0.88*	*0.85*	*0.84*	*1.00*					
11. Composite	**0.70**	**0.73**	**0.72**	**0.70**	**0.66**	**0.71**	*0.96*	*0.94*	*0.92*	*0.95*	*1.00*				
GPA															
12. English	**0.30**	**0.29**	**0.31**	**0.26**	**0.27**	**0.36**	**0.29**	**0.17**	**0.17**	**0.20**	**0.23**	*1.00*			
13. Math	**0.25**	**0.24**	**0.28**	**0.22**	**0.24**	**0.26**	**0.27**	**0.18**	**0.19**	**0.24**	**0.23**	*0.56*	*1.00*		
14. Science	**0.23**	**0.15**	**0.17**	**0.10**	**0.12**	**0.24**	**0.15**	**0.09**	**0.06**	**0.14**	**0.12**	*0.52*	*0.44*	*1.00*	
15. Social Studies	**0.32**	**0.29**	**0.29**	**0.20**	**0.20**	**0.35**	**0.29**	**0.20**	**0.20**	**0.23**	**0.25**	*0.65*	*0.55*	*0.48*	*1.00*

*KCCT was changed in 1999. Tests given prior to 1999 were not used for this analysis. KCCT Reading and Practical Living scores not available for the class of 2000

Table 49. Average Within-Year School-Level Correlations for Schools from 1993-94 Through 1995-96

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Open Response														
1. Reading	*1.00*													
2. Math	*0.75*	*1.00*												
3. Science	*0.84*	*0.79*	*1.00*											
4. Social Studies	*0.83*	*0.79*	*0.85*	*1.00*										
5. Writing Prompt	*0.70*	*0.60*	*0.69*	*0.65*	*1.00*									
ACT														
6. English	**0.52**	**0.58**	**0.54**	**0.51**	**0.60**	*1.00*								
7. Reading	**0.50**	**0.55**	**0.55**	**0.48**	**0.59**	*0.90*	*1.00*							
8. Math	**0.46**	**0.65**	**0.51**	**0.48**	**0.52**	*0.84*	*0.80*	*1.00*						
9. Science Reasoning	**0.53**	**0.62**	**0.60**	**0.53**	**0.59**	*0.89*	*0.91*	*0.85*	*1.00*					
10. Composite	**0.53**	**0.63**	**0.58**	**0.53**	**0.61**	*0.96*	*0.95*	*0.92*	*0.96*	*1.00*				
GPA														
11. English	**-0.02**	**-0.05**	**-0.01**	**-0.05**	**-0.03**	**-0.05**	**-0.03**	**-0.10**	**-0.06**	**-0.06**	*1.00*			
12. Math	**0.05**	**0.03**	**0.06**	**0.02**	**0.07**	**0.06**	**0.05**	**-0.01**	**0.04**	**0.04**	*0.45*	*1.00*		
13. Science	**0.03**	**-0.03**	**0.02**	**0.02**	**0.01**	**0.00**	**0.01**	**-0.08**	**-0.02**	**-0.02**	*0.50*	*0.51*	*1.00*	
14. Social Studies	**0.05**	**0.02**	**0.06**	**0.05**	**0.04**	**0.04**	**0.03**	**-0.03**	**0.03**	**0.02**	*0.50*	*0.56*	*0.42*	*1.00*
15. High School	**0.03**	**-0.01**	**0.03**	**0.01**	**0.02**	**-0.00**	**-0.00**	**-0.07**	**-0.02**	**-0.02**	*0.78*	*0.77*	*0.74*	*0.77*

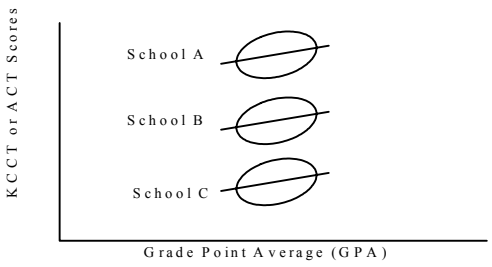
Pooled Within-School Correlations

The above discussion alluded to school-level factors, such as differences in grading practices, which may be impacting observed correlations. Figure 18 depicts an extreme version of such a situation. Schools A, B, and C are clearly different in where their students lie with respect to KCCT or ACT scores, but they are identical in terms of the grades their students receive. Also, within each school, there is a relationship between grades and either KCCT scores or ACT scores. However, if a correlation were calculated using students from all schools, without regard to school-level characteristics, it would be zero.

Pooled within-school correlations are used to estimate relationships between measures calculated within schools and then averaged across all schools. These pooled within-school correlations were calculated for each of the three years of data, and then averaged across the three years.[3] The resulting average pooled within-school correlations are presented in Table 50.

If differences between schools' grading procedures are substantial, and if within schools, students with higher grades also have higher KCCT scores, then the correlations in Table 50 will be higher than student correlations in Table 15. The difference between the GPA correlations in Table 15 and Table 50, however, are only marginally different. In nearly all cases, the within-school correlations are higher, but only by a range of about .01-.06. Thus, grading differences among schools do appear to exist, but the effect is small.

Figure 18. Extreme hypothetical illustration of how mean differences among schools on ACT or KCCT scores that are not mirrored by differences in GPA can impact correlations. (Ellipses represent students' scores within each school).



Comparison of the correlations in Table 50 and Table 15 can also be used to test a hypothesis about the relationship between KCCT and ACT performance. It is suggested above that some schools might be working more successfully toward improving KCCT performance than others. Again, if these efforts are only tangentially affecting ACT scores, then we might expect mean differences among schools on KCCT scores that are not mirrored by differences on ACT. Within schools, however, we can still expect students who do better on KCCT to also have a tendency to do better on ACT. Figure 19 provides an extreme illustration of this potential effect. Comparing correlations between KCCT and ACT from Table 50 and Table 15 reveals no such trend. The differences are all small, suggesting that there are no significant differences among schools in the average KCCT scores of their students that are not mirrored by differences in students' ACT scores. This conclusion is consistent with the earlier conclusion from the individual level data. That is, no strong methodological differences in skills requirements are evidenced. Again, this data is very similar to that of Hoffman (1998) comparing KIRIS to ACT.

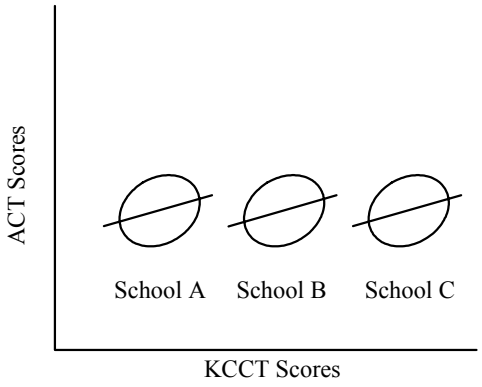
[3] Again, the technical *r* to *z* correction was used.

Table 50. Pooled Within–School Correlation Averaged for Graduation Years 2000-2002

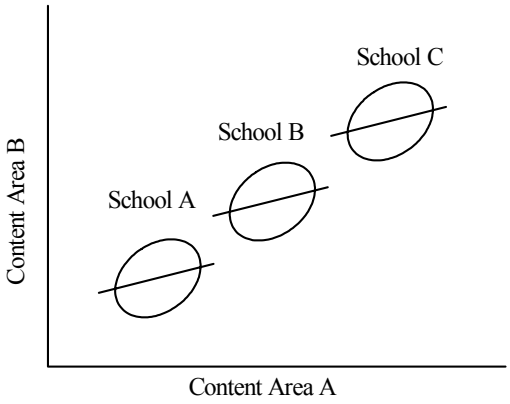
Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
KCCT															
1. Reading*	*1.00*														
2. Math	*0.51*	*1.00*													
3. Science	*0.52*	*0.63*	*1.00*												
4. Social Studies	*0.61*	*0.57*	*0.64*	*1.00*											
5. Arts & Humanities	*0.52*	*0.43*	*0.48*	*0.58*	*1.00*										
6. Practical Living*	*0.51*	*0.38*	*0.40*	*0.45*	*0.38*	*1.00*									
ACT															
7. English	**0.62**	**0.63**	**0.58**	**0.62**	**0.50**	**0.45**	*1.00*								
8. Reading	**0.57**	**0.55**	**0.57**	**0.58**	**0.45**	**0.41**	*0.75*	*1.00*							
9. Math	**0.47**	**0.75**	**0.59**	**0.53**	**0.40**	**0.36**	*0.69*	*0.60*	*1.00*						
10.Science Reasoning	**0.49**	**0.64**	**0.59**	**0.53**	**0.40**	**0.36**	*0.69*	*0.69*	*0.72*	*1.00*					
11. Composite	**0.62**	**0.72**	**0.66**	**0.65**	**0.51**	**0.45**	*0.90*	*0.88*	*0.84*	*0.87*	*1.00*				
GPA															
12. English	**0.49**	**0.40**	**0.37**	**0.45**	**0.38**	**0.35**	**0.49**	**0.41**	**0.41**	**0.37**	**0.48**	*1.00*			
13. Math	**0.42**	**0.54**	**0.40**	**0.40**	**0.32**	**0.30**	**0.46**	**0.36**	**0.56**	**0.44**	**0.52**	*0.61*	*1.00*		
14. Science	**0.42**	**0.45**	**0.39**	**0.41**	**0.34**	**0.31**	**0.45**	**0.38**	**0.48**	**0.41**	**0.49**	*0.64*	*0.65*	*1.00*	
15. Social Studies	**0.42**	**0.39**	**0.36**	**0.41**	**0.34**	**0.30**	**0.43**	**0.37**	**0.41**	**0.37**	**0.45**	*0.64*	*0.58*	*0.57*	*1.00*

*KCCT was changed in 1999. Tests given prior to 1999 were not used for this analysis. KCCT Reading and Practical Living scores not available for the class of 2000

A third comparison can also be made with the pooled within-school correlations. This concerns the intercorrelations within each assessment format. Pooled within-school KCCT and ACT intercorrelations from Table 50 show a slight decrease from the student-level intercorrelations in Table 15. It is possible that this is due to an increased homogeneity for the pooled within-school results. However, Figure 20 presents an exaggerated illustration of another manner in which this difference might be obtained. This pattern would yield higher correlations for all students than for students within a school and a higher correlation of school-level scores than for student-level scores. Although small, this is the pattern of differences in correlations obtained for both KCCT intercorrelations and for the ACT intercorrelations. The obtained pattern, like that in Figure 20 but much less exaggerated, could result from differences between schools in the population differences of their students, from differences in instruction that impact KCCT and ACT test scores, or both.



Extreme hypothetical illustration of how mean differences among schools on KCCT scores that are not mirrored by differences on ACT scores can impact correlations. (Ellipses represent students' scores within each school.)



Exaggerated illustration of how mean differences among schools can increase overall correlations. (Ellipses represent students' scores within each school.)

Figure 19. (left) Hypothetical illustration of how mean differences among schools can impact correlations.

Figure 20. (right) Exaggerated illustration of how mean differences among schools can increase correlations.

School-level Instructional Practices

At the end of each section of the KCCT, students complete a brief questionnaire with items designed to measure perceptions of preparedness, performance and motivation, the types of learning activities in which students regularly take part, as well as some information on demographics and transience. Responses to items asking students about the amount of time they spent on certain activities were analyzed in order to explore the relationship between instructional practices and scores on the KCCT and ACT.

Table 51 presents correlations between KCCT and ACT scale scores and responses to student questionnaire items that asked about time spent on certain learning activities (a list of variable names and the associated questionnaire items is provided in the Appendix). As the structure of the student questionnaire has changed over time, data from only those students who were administered identical versions of the questionnaire were analyzed. In this case, responses to the 10th grade student questionnaires administered in the springs of 1999 and 2000 were used. Correlations represent relationships between variables aggregated at the school level, in order to compare instructional practices among higher and lower performing schools.

Notable correlations include the negative relationships between KCCT and ACT scale scores and the amount of time spent reading newspapers, journals or magazines (*newspaper*), participating in programs that reward students for the number of books read (*books*), and learning new reading strategies (*strategy*). Here, new reading strategies may be referring to remedial level instructional practices designed to improve the skills of students who have difficulty with basic reading mechanics. Schools that require more time to be spent on corrective teaching may be lower performing on an assessment such as the ACT. An alternative explanation might be that schools with a larger number of low performing students have experienced low levels of achievement on tests such as the KCCT or ACT. In response to low levels of achievement, a school might choose to implement more remedial level classes, resulting in the negative correlation between test scores and use of reading strategies.

Though most of the correlations presented in Table 51 do not stand out in terms of their magnitude, some interesting patterns can be pointed out. The *discuss* variable exhibits a fairly strong, positive correlation with all the measures of achievement. Schools in which students spend more time discussing what they have read with their classmates tend to show higher scores on KCCT and ACT assessments. Variables that exhibited consistently negative relationships with the measures of student achievement include the aforementioned *newspaper*, *books* and *strategy*, along with a variable that measured the amount of time students spent reading independently in a reading/writing workshop (*workshop*) and another that asked students how often they used graphic organizers or plot maps when reading passages. It is important to remember that variables correlated positively or negatively do not imply cause and effect, however. These results do not represent a recommendation to adopt or discard particular instructional practices.

Student-level intercorrelations were calculated among the variables in order to explore possible relationships. The results are presented in Table 52 (a list of variable names and the associated questionnaire items is provided in the Appendix). Student-level correlations were used in this section in order to explore what types of activities individual students were involved in. For example, a student who reported spending a good deal of time reading novels might also be expected to spend time discussing what was read. The correlation between activities was expected to provide information about what types of classes students were taking.

Table 51. School-Level Correlations Among KCCT, ACT and Student Reading Questionnaire Items for Graduation Years 2001-02*

Variable	Workshop	Discuss	Maps	Novels	Newspaper	Preview	Strategy	Respond	Vocabulary	Books
KCCT										
1. Reading	-.046	.375	-.017	.137	-.241	.112	-.135	.106	.152	-.174
2. Math	-.002	.303	-.189	.089	-.195	.056	-.218	-.027	-.015	-.206
3. Science	-.049	.310	-.123	.070	-.255	.094	-.226	-.049	.072	-.229
ACT										
7. English	-.086	.346	-.144	.114	-.244	.037	-.256	-.036	0.87	-.224
8. Reading	-.079	.159	-.142	-.022	-.322	-.045	-.371	-.191	.067	-.194
9. Math	-.111	.277	-.149	.059	-.266	.002	-.278	-.033	.011	-.204
10. Science Reasoning	-.160	.215	-.252	-.087	-.367	-.098	-.377	-.126	-.052	-.219

* The structure of the student questionnaire has changed over time. Data from only those students who were administered identical versions of the questionnaire were analyzed. In this case, responses to the 10th grade student reading questionnaires administered in the springs of 1999 and 2000 were used.

Table 52. Student-Level Intercorrelations Among Student Reading Questionnaire Items

	Workshop	Discuss	Maps	Novels	Newspaper	Preview	Strategy	Respond	Vocabulary	Books
workshop	1.00									
discuss	.354	1.00								
maps	.244	.283	1.00							
novels	.330	.351	.153	1.00						
newspaper	.004	-.055	.100	-.006	1.00					
preview	.270	.394	.349	.301	-.040	1.00				
strategy	.232	.275	.364	.200	.135	.426	1.00			
respond	.309	.412	.262	.373	-.052	.386	.315	1.00		
vocabulary	.179	.224	.196	.221	.045	.229	.255	.293	1.00	
books	.136	0.57	.159	.084	.079	.114	.160	.079	.085	1.00

Table 52 shows several reasonably high positive correlations among the student questionnaire items. Only two variables, *newspaper* and *book*, show consistently low intercorrelations with the other student questionnaire items. Among the highest intercorrelations are the relationships between *respond* and *discuss* and *preview* and *strategies*. Students who spend more time responding in writing to what they have read (*respond*) also spend more time discussing what they've read with their classmates (*discuss*). Students who learn new strategies to use in reading (*strategy*) also spend more time previewing or planning before they read (*preview*). It seems that certain activities may be more representative of higher level courses (*discuss* and *respond*) while others may be more indicative of a remedial level course (*preview* and *strategy*). Principal components analysis was conducted to test this possibility.

Table 53 presents results from a principal components analysis using the 10 variables from Table 51. Some variables can be clearly associated with a particular component, while others exhibit a more ambiguous relationship. Independent reading in workshops, discussion of readings, reading novels, previewing before reading and responding in writing (*workshop*, *discuss*, *novels*, *preview* and *respond*) are all associated with the first component, reading newspapers and participating in programs that reward for numbers of books read (*newspaper* and *books*) load highly on the second component. Not so clearly demarcated are the variables that measure the use of maps, the learning of new reading strategies and working on vocabulary (*maps*, *strategy* and *vocabulary*). *Maps* and *strategy* load higher on the second component than the first, but nevertheless load relatively high on both. Component 1 appears to be capturing something unique to courses that involve more analytic reading skills, while Component 2 seems related to courses in basic reading mechanics. However, the distinction between the two is somewhat ambiguous and may warrant further exploration.

Table 53. Principal Components Analysis of Student Reading Questionnaire Items

Variable Name	Component 1	Component 2
workshop	.588	.102
discuss	.724	-.007
maps	.417	.517
novels	.645	-.047
newspaper	-.227	.699
preview	.660	.220
strategy	.462	.549
respond	.724	.032
vocabulary	.437	.234
books	.069	.527

Similar analyses can be conducted using the 11th grade student questionnaires from spring 2001. Table 54 presents correlations between ACT and KCCT scale scores and items from the student math questionnaire (a list of variable names and the associated questionnaire items is provided in the Appendix).

Table 54. School-Level Correlations Among KCCT, ACT and Student Math Questionnaire Items for Graduation Year 2002*

Variable	Groups	Project	Calculator	Computer	Hands-on materials	Create graphs	Discuss	Real life
KCCT								
1. Reading*	-.121	-.047	.232	.158	.017	-.206	.115	-.070
2. Math	-.180	-.198	.100	.060	-.032	-.050	.096	-.260
3. Science	-.093	-.162	.060	.068	-.168	-.144	.046	-.170
ACT								
7. English	.010	-.003	.201	.103	.128	-.097	.138	.002
8. Reading	.151	.110	.164	.136	.067	-.225	.022	.235
9. Math	.005	-.029	.192	.107	.116	.004	.090	-.125
10. Science Reasoning	-.012	-.084	.147	.131	.018	-.119	.031	-.027

*The structure of the student questionnaire has changed over time. Data from only those students who were administered identical versions of the questionnaire were analyzed. In this case, responses to the 11th grade student math questionnaires administered in the springs of 2001 were used.

As Table 54 shows, though all correlations are not particularly high in magnitude, certain variables exhibit a consistently positive relationship with test scores. Schools in which students spend more time using graphing calculators, using computers and discussing different ways to solve problems (*calculator*, *computer* and *discuss*) tend to have higher scores on KCCT and ACT. Other variables exhibit weaker relationships that are both positive and negative in direction. However, four variables have consistently negative correlations with KCCT assessments. Schools in which students spend more time in their math classes working in groups, working on math projects, drawing pictures or graphs and working on math that is related to real-life experiences (*groups*, *project*, *create graphs* and *real life*) tend to have lower scores on KCCT. Once again, working under the assumption that the use of graphing calculators/computers and discussion are associated with higher level math courses, these relationships could be explained in more than one way. Schools that require more time to be spent on teaching strategies such as math projects and real-life linkage may be lower performing on KCCT and ACT assessments. Schools that have implemented such strategies in response to low levels of student achievement would experience these negative correlations. Students who spend time using graphing calculators and computers and discussing problem solving may be studying more abstract mathematical concepts, which are typically part of upper level math courses, such as Calculus. It would be expected that schools with a larger proportion of students taking upper level math would have higher average math scores on KCCT and ACT.

Other school characteristics

Table 55 presents school-level correlations among additional student questionnaire items, designed to measure levels of transience and other demographic characteristics (a list of variable names and the associated questionnaire items is provided in the Appendix). As can be expected, schools with high proportions of student absence (*miss school*) and student transience (*change schools*) tend to have lower average scores on the ACT and KCCT. The most noticeable correlation is that of scale scores and the number of books in students' homes (*books at home*). A component of SES, this questionnaire item asked students to report how many books there are in their homes. Schools with higher scores on this item tend to have higher average scale scores on both the ACT and KCCT assessments. Also interesting was the positive correlation between students' descriptions of their overall grades (*grades*) and their scale scores. Schools with a higher proportion of students reporting good grades also tend to perform well on ACT and KCCT, supporting the previous conclusion that grading may be becoming more standardized.

Table 55. School-Level Correlations Among KCCT, ACT and Additional Student Reading Questionnaire Items for Graduation Years 2001-2002

Variable	Lived in KY	Came to this school	Miss school	Books at home	Change schools	Speak English	Grades
KCCT							
1. Reading	.005	-.028	-.096	.254	-.082	-.030	.345
2. Math	-.027	-.016	-.134	.250	-.067	-.007	.347
3. Science	-.023	.001	-.118	.258	-.063	-.002	.308
ACT							
7. English	-.039	-.044	-.097	.323	-.053	-.007	.351
8. Reading	-.047	-.032	-.062	.302	-.040	-.004	.301
9. Math	-.057	-.028	-.128	.269	-.045	.020	.350
10. Science Reasoning	-.047	-.025	-.101	.263	-.045	-.005	.322

*The structure of the student questionnaire has changed over time. Data from only those students who were administered identical versions of the questionnaire were analyzed. In this case, responses to the 10th grade student questionnaires administered in the springs of 1999 and 2000 were used.

Summary and Conclusion

The purpose of this report is to explore the validity question: "Are KCCT scores appropriately related to other measures of educational achievement?"

The data presented in this report suggest two main points:

- Students who do well on any of the assessments tend to do well on all of the assessments—KCCT, ACT, or GPA—and they tend to be the students who take the more advanced mathematics classes.
- When schools' means are calculated using only the ACT-taking population of students, schools with high scores on ACT also have high KCCT scores. At the school level of analysis, GPA is not strongly related to either KCCT or to ACT. This is presumably due to differences in grading standards between schools. Both ACT and KCCT, however, exhibit stronger relationships to GPA than those found by Hoffman (1998) for ACT and KIRIS for 1993-96. This may indicate that grading is becoming more standardized among Kentucky schools.

KCCT exhibits strong convergent validity coefficients. Correlations between KCCT and ACT are strong, but not so strong as to indicate that the two tests are interchangeable. KCCT is positively correlated with other measures of student achievement including course grades and number of courses. Gains on KCCT are reflective of changes on ACT at the school level. All these data provide strong evidence in support of KCCT as a valid measure of student achievement.

There are, however, a few clarifications and qualifications to these general conclusions, but none that diminish the basic findings. These clarifications and qualifications include the following:

Changes in scores. Mean KCCT scores experienced an increase, while ACT mean scores showed a decrease over the three years included in this study. However, changes between the two assessments are positively correlated. Schools that have gained more in terms of KCCT scores have also experienced less of a decrease, and sometimes have experienced a gain, on ACT scores.

It is not surprising that KCCT and ACT scores are not perfectly correlated. The two tests are tied to different content domains, use different format items, and were designed to serve very different purposes. However, it is clear from the data that students who tend to perform well on KCCT can also be expected to perform well on ACT and vice-versa. It is also clear from the data that schools that perform well on one test can be expected to perform well on the other. It is less clear, but never the less the case that schools that improve on one test can be expected to improve on the other. There is no indication from this data that preparing students to perform well on the KCCT will result in a decline in scores on the ACT. In fact, the opposite is true.

ACT percentile rankings. Kentucky students differ only slightly from the national ACT-taking student population on ACT percentile rankings. Fewer Kentucky students score within the top 10% of the score distribution, while more Kentucky students are clustered at the bottom. These findings are more of a reflection of Kentucky colleges' and universities' ACT requirement than of issues related to student preparation. Students who are interested in pursuing a postsecondary education within Kentucky are required to take the ACT, resulting in a larger proportion of Kentucky students taking the ACT compared to other states. Only seven states had a higher percentage of graduates tested on the ACT than Kentucky for the graduating class of 2002 (ACT, 2002b).

Discriminant validity. At both the student level and the school level, the different assessments of mathematics achievement are more highly related to each other than to assessments of other subjects. Students with high mathematics scores on one assessment will tend to do well on all other assessments, but that tendency is most pronounced for other mathematics assessments. The same holds for school scores. There is a similar differentiation in science for school scores, but not as clearly as for mathematics. For reading, writing, and social studies, there is little evidence that student performance is clearly differentiated by subject area.

Differences across test forms. KCCT is administered, in order to capture the broad range of Core Content, using 6 test forms. Correlations between KCCT and ACT were similar in magnitude when broken out by form number, indicating that none of the test forms are measuring achievement differently from the other test forms.

Student motivation. Student motivation, often suggested to be a factor in differential performance on KCCT and ACT, could not be measured accurately from the data used by this analysis. Student questionnaire items meant to determine students' motivation to do well instead seem to be measuring student's perceptions of test difficulty; at least for the matched student population. On math, science and social studies tests, the majority of students who claimed not to try on the exam also believed that they had done well. This was mirrored in a slight peak in KCCT scale scores at the low end of the effort spectrum. Alternative measures of student motivation should be developed in order to accurately test this hypothesized relationship between motivation and KCCT.

Measurement method effects. The results do show measurement method effects but not in a way that cleanly identifies the difference in performance requirements between the KCCT format and the ACT format. For student-level scores, KCCT assessments are generally related to ACT scores about as strongly as they are to each other. ACT scores tend to be more highly related to each other than to either KCCT scores or to GPA. KCCT scores have experienced a slight increase over the three year period discussed in this report, with ACT scores exhibiting a slight decrease. This difference is, however, very small, and does not suggest that changes in instructional patterns have affected ACT scores or that the two assessments are measuring achievement in vastly different ways.

GPA shows positive relationships with KCCT and ACT assessments at the student level, but not so much at the school level. This is interpreted as being due to

differences in schools' grading practices. Grading practices apparently differ sufficiently to reduce school-level associations with KCCT and ACT scores.

Gender, race and socioeconomic status. Neither gender, race or socioeconomic status appear to influence the KCCT scores any more than would be expected based on observed differences for ACT scores. In other words, KCCT items are not injecting any unexpected gender, racial or socioeconomic bias. The possible exception to this general conclusion is that males appear to have slightly lower KCCT reading scores than would be expected from their ACT scores. Also interesting is the ratio of males and females who take the ACT. Females outnumber males by nearly 3 to 2. This result – coupled with consistently high GPAs for females, but mixed means for test results – suggests that Kentucky girls are more motivated academically than Kentucky boys.

School-level instructional practices. Analysis of student questionnaire items from the KCCT yielded ambiguous results. Schools that spent more time on certain activities associated with lower level or remedial courses tended to also have lower average scale scores on the ACT. Why these relationships exist, however, cannot be so easily explained. It could be the case that schools that require more time to be spent on corrective teaching may be lower performing on assessments such as ACT. On the other hand, schools with a larger number of low performing students may have found it necessary to implement more remedial level teaching practices, resulting in a negative correlation between test scores and the use of corrective teaching.

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Appendix

The following list contains the questionnaire items and coordinating variable names that are presented in Tables 44 through 46:

In your Reading or Language Arts class, how often do you do the following things?

- *workshop*- read independently in a reading/writing workshop
- *discuss*- discuss what you read with your classmates
- *maps*- use graphic organizers or plot maps for passages you read
- *novels*- read novels, short stories, or poems
- *newspaper*- read newspapers, journals, or magazines
- *preview*- spend time previewing or planning before you read
- *strategy*- learn new strategies to use in reading
- *respond*- respond in writing to what you have read
- *vocabulary*- work on vocabulary
- *books*- participate in a program that rewards you for the number of books you read

The following list contains the questionnaire items and coordinating variable names that are presented in Table 47:

In your Mathematics class, how often do you do the following things?

- *groups*- work with other students in pairs, small groups, or teams
- *project*- work on mathematics projects/investigations that require more than one class period
- *calculator*- use a graphing calculator
- *computer*- use a computer
- *hands-on material*- use hands-on materials other than books, worksheets, calculators, or computers
- *create graphs*- draw pictures, charts, or graphs to help explain your thinking
- *discuss*- discuss different ways to solve problems
- *real life*- work on mathematics that is related to real-life experiences

The following list contains the questionnaire items and coordinating variable names that are presented in Table 48:

- *lived in ky*- How long have you lived in Kentucky?
- *came to this school*- When did you come to this school?
- *miss school*- How many days of school did you miss last month?
- *books at home*- About how many books are there in your home?
- *change schools*- Within the past two years, how many times have you changed schools because you changed where you live?
- *speak English*- How often do the people in your home speak a language other than English?
- *grades*- Mark the statement that best describes your overall grades this year.